ARCADIS
GERAGHTY & MILLER

Focused Feasibility Study

General Die Casting
Company,
13700 Mt. Elliott
Detroit, Michigan

P R E P A R E D F O R

General Die Casting Company
2644 Comfort
West Bloomfield, Michigan 48323

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Introduction

This document summarizes the results of a focused feasibility study (FFS) completed by ARCADIS Geraghty & Miller (formerly Geraghty & Miller), on behalf of the General Die Casting Company, for the General Die Casting property located at 13700 Mt. Elliott Avenue in Detroit, Michigan (see Figure 1). The objective of the FFS was to facilitate the development and selection of an environmentally sound, cost-effective remedial alternative which may be implemented at impacted areas of the site and the driveway of the adjacent Central Steel & Wire property (see Figure 2) to ensure the protection of human health and the environment. This FFS was prepared to comply with the overall qualifications of remedy selection under the Comprehensive Environmental Response, Compensation and Liabilities Act (CERCLA).

A comprehensive review of available remedial alternatives was undertaken during the FFS process; however, the intent of the selected environmental remedy is to enable the remedial action to be completed in conjunction with the following events:

- Demolition of the General Die Casting building.
- Reconstruction of the Central Steel & Wire driveway located adjacent to the south of the General Die Casting property to allow for heavy truck traffic.

Thus, although a comprehensive overview of potential environmental remedies was completed, only those alternatives suited for implementation with the future property plans were retained for further consideration and cost evaluation.

The following documents were reviewed and utilized to obtain historical site information during the preparation of this FFS:

- Performance of a Limited Soil Sampling Study Draft Report, Gabriel Laboratories, Ltd., September 8, 1989.
- Remedial Closure Report for PNA Contamination of Soil, TOXICO Corporation , October 10, 1990.
- Report of Soil Investigations and Preliminary Remedial Plan, TOXICO, December 2, 1994.
- Exterior Wall Crack Seepage Liquid Summary Letter, Gabriel Environmental Services, May 8, 1996.
- Analytical Data of Wipe Samples Collection Summary Letter, ARCADIS Geraghty & Miller, January 2, 1998.
- Phase II Remedial Investigation Report, ARCADIS Geraghty & Miller, May 8, 1998.

- Supplemental Site Investigation Work Summary Letter, ARCADIS Geraghty & Miller, May 13, 1999.

Investigative soil boring logs and laboratory data contained within the above reports have not been reproduced in this document.

For ease in presenting the relevant site information, this report has been subdivided into the following sections:

- Site Background Summary
- Site-related Investigation Summary
- Geologic/Hydrogeologic Summary
- Regulatory Cleanup Criteria Evaluation
- Site Environmental-quality Summary
- Remedial Technology Evaluation

Site Background Summary

Site Location

The General Die Casting site is an approximately 0.6-acre site located at 13700 Mt. Elliott Avenue in Detroit, Michigan (see Figure 1). An approximately 21,000-square foot building constructed of brick and concrete block and formerly utilized for zinc die casting and electroplating operations is located at the southwestern corner of the site. The eastern portion of the General Die Casting property is not paved, and the exposed surface soils consist of a dark brown granular material that includes concrete and brick fragments, gravel, coal, metallic slag, and scrap metal. Grass or gravel surface cover is present immediately south of the site building, and the western portion of the site is landscaped. The northern portion of the site is concrete or asphalt-paved (see Figure 2).

The General Die Casting site is situated within the northwestern quarter of Section 16, Township 1 South, Range 12 East (see Figure 1). According to the United States Geological Survey (USGS) 7.5-minute Highland Park, Michigan topographic map, no surface water bodies are present within at least a 1-mile radius of the site, and the general site area elevation is approximately 625 feet above mean sea level. Based on site observations, the elevation of the General Die Casting site appears to be approximately 4 to 5 feet higher than the properties to the east, south, and west.

The site is bordered to the north by Gallagher Kaiser, to the west by Mt. Elliott Avenue, to the east by railroad tracks, and to the south by Central Steel & Wire (see Figure 2), all of which are zoned for heavy or moderate manufacturing site use. The portion of the Central Steel & Wire driveway that extends easterly from Mt. Elliot Avenue approximately 300 feet is the area designated for reconstruction (see Figure 2).

The site building can generally be divided into three former operational areas. The drum storage and office areas were located in the western portion of the building; the electroplating area was located in the center; and the electroplating wastewater treatment system was located within the eastern portion of the building (see Figure 2). The TOXICO report issued in 1994 stated that the site building had been subjected to significant vandalism and deterioration, with portions of the roof no longer intact. This description is consistent with ARCADIS Geraghty & Miller's observations of the site building in 1999.

Historical Site Use

A 1951 Sanborn fire insurance map of the site area indicates the site building had not yet been constructed, and a scrap steel storage yard operated by the Morrow Steel Company was present at the site. According to historical documentation, zinc die casting and electroplating operations were conducted at the site from the mid 1950s through 1988. No further industrial activities have occurred at the site since the cessation of the zinc die casting and electroplating operations. Available property ownership information is detailed below.

According to the 1994 TOXICO report, Wolverine Die Casting Corporation occupied the site from the mid-1950s until 1966 and conducted zinc die casting and electroplating operations within the site building. On May 1, 1966, Wolverine Die Casting was acquired by Noranda Mines, which conducted zinc die casting and electroplating at the site until March 31, 1970. General Die Casting purchased the property in July 1970 and continued to conduct zinc die casting and electroplating operations on-site until December 1988.

In January 1989, a property sales agreement was executed between General Die Casting and Mr. William R. Aikens, an agent for a corporation to be formed at a later date. Keys to the facility and the deed for this transaction were transferred to Mr. Aikens; however, the deed was never officially recorded. According to the 1994 TOXICO report, no subsequent plating nor manufacturing activities were reportedly conducted on-site by Spartan Metal Finishing Company (Spartan Metal), an entity

associated with Mr. Aikens. However, Spartan Metal reportedly removed equipment and materials from the site.

Site-related Investigations Summary

Initial Site Investigations

In August 1988, because of the anticipated property sale to Mr. Aikens, TOXICO completed a Level I Environmental Assessment at the General Die Casting site. The assessment identified visible staining along the southern building wall and surface-soil staining to the south of the site building. Surface- and near-surface-soil samples were collected within this area in September 1988, and polynuclear aromatic hydrocarbon (PAH) impacts above regulatory cleanup levels were reported. A sampling event to delineate the extent of PAH impacts in this area was completed in January 1989. Forty-six soil borings were completed, and soil samples were collected from depths 18 inches and 48 inches below ground surface at each boring. The results of this investigation indicated that the PAH impacts extended approximately 4 feet south of the southern building wall, to a depth 4 feet below ground surface. The PAH impacts were observed to be limited to a grass- and gravel-covered area that extended onto the Central Steel & Wire property (within their northern driveway).

In July 1990, TOXICO excavated approximately 420 cubic yards of soil from the previously delineated PAH-impacted area (see Figure 3) and disposed of the soil at a Browning-Ferris Industries (BFI) landfill, in accordance with a Remedial Action Plan (RAP) that had been submitted to the Michigan Department of Natural Resources (MDNR), now known as the Michigan Department of Environmental Quality (MDEQ). Confirmatory sampling of the excavation floor and sidewalls indicated elevated cyanide concentrations in the soil. Elevated cyanide concentrations were also reported in water that had accumulated in the excavation due to a damaged plastic excavation cover and slow seepage through the sidewalls. Resampling of the excavation by representatives of TOXICO (on behalf of General Die Casting), Gabriel Laboratories (on behalf of Central Steel & Wire), and the MDNR identified elevated cyanide concentrations in soil and water. In addition, the MDNR samples exhibited elevated concentrations of nickel, copper, and zinc in the soil. In September 1990, a plastic liner was placed at the bottom and along the sides of the excavation, and clean fill was used to backfill the excavation.

In January 1991, a site assessment completed at the General Die Casting site by the United States Environmental Protection Agency (USEPA) Technical Assistance Team

identified 22 drums of waste believed to contain heavy metals and cyanide at the site and identified a green crystalline material inside a diked containment area within the building. The drums were removed from the site in May 1991, and additional waste material was observed within treatment tanks and plating vats inside the site building at that time.

In January 1992, an 8-inch fire main ruptured and flooded the southwestern portion of the General Die Casting building, and Central Steel & Wire reported the release of an unknown liquid from the General Die Casting site to the USEPA. The USEPA initiated emergency removal activities in March 1992 to stabilize potential health threats posed by chemicals and process materials in the General Die Casting building. The emergency response activities consisted of removing approximately 1,400 gallons of acid liquids and 4,800 gallons of other liquids from the site.

Administrative Order by Consent

On March 16, 1993, General Die Casting entered into an Administrative Order by Consent (AOC) with the USEPA to "abate conditions which may present an imminent and substantial endangerment to the public health or welfare of the environment because of an actual or threatened release of hazardous substances at the site." The AOC was issued under Section 106 of CERCLA of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. General Die Casting retained TOXICO to investigate the soil impacts, and Spartan Metal was directed to address the interior building cleanup.

The TOXICO Work Plan for the soil investigation was approved by the USEPA in April 1994 and consisted of a sampling program to evaluate the magnitude and extent of soil impacts at the site, identify background concentrations of the constituents of concern (COCs), and verify the site geological and hydrogeological conditions.

TOXICO completed the soil investigation from April through September 1994. During this investigation, 104 soil borings were advanced to a maximum depth approximately 14 feet below ground surface throughout the General Die Casting site area, through the floor of the General Die Casting site building, and within the northern driveway of the Central Steel & Wire property (see Figure 4). Soil samples were collected from these borings and submitted to an off-site laboratory for one or more of the following analyses:

- Total and reactive cyanide.
- Total and reactive sulfide.

- Total priority pollutant metals, plus copper, nickel, and zinc.
- PAHs.
- Volatile organic compounds (VOCs).

In addition, TOXICO completed 14 soil borings at properties to the northwest, north, and south of the General Die Casting site to determine local background concentrations (see Figure 5). The background soil samples were analyzed for metals and cyanide; although based on reported site conditions, only the analytical data from the background fill material samples were used to calculate a site-specific background soil concentration for lead. Background soil concentrations were calculated using the MDEQ Guidance Document *Verification of Soil Remediation (1994),* using the mean plus three standard deviation approach. The calculated background soil concentrations of lead in the fill material, in the vicinity of the General Die Casting property, is 865,000 micrograms per kilogram (ug/kg).

The results of the site investigation indicated arsenic, lead, chromium, and PAH concentrations in soils were above the then-applicable MDNR Type C Cleanup Criteria. No cyanide exceedances of the Type C Cleanup Criteria were reported in soils. The regulatory cleanup exceedances were generally limited to the soils immediately underlying the southern portion of the building floor (beneath the former plating process areas) and within areas south of the building that extended onto the Central Steel & Wire property. PAHs, arsenic, and lead exceedances were also reported in the near-surface soils east of the site building. However, the TOXICO report stated these concentrations were likely the result of historic site maintenance activities and not on-site industrial activities. Upon conclusion of this soil investigation, TOXICO recommended the use of engineering controls (i.e., direct contact barriers and deed restrictions) as the most applicable and cost-effective remedial alternative to prevent unacceptable exposures to site-related impacts.

Central Steel & Wire Site Investigations

In May 1996, Central Steel & Wire reported a green substance seeping through a crack in the northern wall of its site building, approximately 50 feet east of the northeastern building corner and 3 feet below ground surface. Analysis of this substance identified total cyanide at concentrations up to 207 milligrams per wipe (mg/wipe). The USEPA visited the site in May 1997 to evaluate the condition of the reported seep.

In July 1997, Geraghty & Miller collected additional wipe samples from the documented Central Steel & Wire seep areas on behalf of General Die Casting. The wipe samples were collected from the green crystalline salt deposits identified in the

seep areas and analyzed for total cyanide and hexavalent chromium. Geraghty & Miller cleaned the seep areas with water and a mild laboratory detergent and resampled the seep areas for total cyanide and hexavalent chromium. The results of the laboratory analyses indicated total cyanide and hexavalent chromium were present in the samples collected prior to cleaning at maximum concentrations of 1.5 mg/wipe and 1.4 mg/wipe, respectively. The analytical results of the wipe samples collected after cleaning the seep areas did not report detectable concentrations of total cyanide or hexavalent chromium. Thus, Geraghty & Miller recommended cleaning the seep areas and sealing them with a masonry sealant to prevent future seeps from occurring in the foundation wall; this was completed by ARCADIS Geraghty & Miller in January 1998.

Groundwater and Additional Soil Investigations

During the previous site investigations, TOXICO had identified perched water zones within the surficial fill material. The perched water was not considered to be groundwater, and no monitoring wells were installed at the site. Because of the occurrence of the liquid seeps into the Central Steel & Wire building, however, General Die Casting retained ARCADIS Geraghty & Miller to evaluate the presence of groundwater at the site.

In January 1998, ARCADIS Geraghty & Miller installed three monitoring wells in the northern driveway of the Central Steel & Wire property and three monitoring wells at the General Die Casting site (see Figure 6). ARCADIS Geraghty & Miller collected continuous soil samples during the monitoring well installation activities to characterize site geologic and hydrogeologic conditions and determined groundwater was present within the shallow fill material at the site as a perched unit within this fill material. A full description of the site geology and hydrogeology is presented in the next section.

During the monitoring well installations, ARCADIS Geraghty & Miller collected soil samples from a depth interval 2 to 4 feet below ground surface and submitted them for total metals, total cyanide, reactive cyanide, and weak acid dissociable cyanide analyses. The results of the soil analyses did not indicate any compounds to be present above the then-applicable MDEQ industrial direct human contact criteria or site-specific calculated background concentrations.

In addition, ARCADIS Geraghty & Miller collected perched groundwater samples from each of the six monitoring wells and submitted them for VOC, semi-volatile

organic compound (SVOC), dissolved metals, total cyanide, reactive cyanide, and weak acid dissociable cyanide analyses. The analytical results of the perched groundwater samples indicated that perched groundwater impacts were limited to an area south of the site building's former plating pit area and were not widespread. Dissolved concentrations of copper, selenium, trivalent chromium, reactive cyanide, and weak acid dissociable cyanide were reported above the then-applicable MDEQ health-based drinking water criteria; however, only weak acid dissociable cyanide at Monitoring Well MW-2 was reported above the then-applicable MDEQ groundwater contact criterion.

ARCADIS Geraghty & Miller conducted a second perched groundwater sampling event in December 1998. Perched groundwater samples were collected from each of the six monitoring wells and submitted for metals and cyanide analyses. In general, the analytical results reported for the two sampling events were consistent in magnitude.

Finally, in March 1999, ARCADIS Geraghty & Miller completed 20 Geoprobe soil borings within the northern driveway of the Central Steel & Wire property. This investigation was completed because it was determined that driveway reconstruction activities would require the excavation of existing soils to a depth approximately 33 inches below ground surface. The soil borings were advanced to a depth 10 feet below ground surface in a grid pattern between the existing Monitoring Wells MW-1 and MW-3 (see Figure 7).

Three soil samples were collected from each soil boring at depths 0 to 1 foot, 1 to 2 feet, and 2 to 3 feet below ground surface and submitted for total cyanide, amenable cyanide, and weak acid dissociable cyanide analyses. Perched groundwater samples were also collected from 11 soil borings (GP-1, GP-3, GP-4, GP-6, GP-8, GP-10, GP-11, GP-13, GP-15, GP-17, and GP-19) to evaluate the lateral extent of cyanide in perched groundwater. The perched groundwater samples were collected from a depth 4 to 5 feet below ground surface at each boring, and a second perched groundwater sample was collected from Boring GP-4 at a depth 6 to 7 feet below ground surface to vertically profile the cyanide impacts. The soil analytical results indicated cyanide concentrations in excess of applicable regulatory criteria (direct contact criteria) at Borings GP-2 and GP-3, and the perched groundwater analytical results reported an exceedance of the applicable regulatory cyanide criteria (groundwater direct contact criteria) at Boring GP-4 (see Figure 7). The soil and perched groundwater analytical results are presented in a later section of this document entitled "Environmental-quality Summary." Thus, soil and perched groundwater impacts above the regulatory

direct contact criteria are present in the area proposed for the Central Steel & Wire driveway reconstruction activities.

Geological/Hydrogeological Summary

Geology

According to site investigations and soil boring logs completed by TOXICO and ARCADIS Geraghty & Miller, fill material ranging from approximately 2 to 10 feet thick is present immediately below ground surface at the site. A continuous gray silty clay unit is present immediately below the fill material, and this clay unit was documented to be a minimum 6 feet thick and extend to a minimum depth 14 feet below ground surface (depth of deepest soil boring).

The fill material, as classified by TOXICO, consists of relatively homogeneous sand fill and other materials such as concrete and metal fragments, brick, gravel, and coal. TOXICO reported that the percentage of sand within the fill was greater on the Central Steel & Wire property than on the General Die Casting property, the Gallagher Kaiser property, or the neighboring properties evaluated.

Consistent with the TOXICO findings, ARCADIS Geraghty & Miller identified the subsurface geology in the three soil borings conducted in the northern driveway of the Central Steel & Wire property to consist of approximately 2.5 to 6 feet of dark brown to black sandy fill material overlying a continuous gray silty clay unit. The subsurface geology of the General Die Casting property consists of approximately 7 to 9.5 feet of dark brown to black sandy fill material, containing variable amounts of other fill materials, overlying the gray silty clay unit.

Hydrogeology

Based on subsurface conditions observed during the installation of the six site monitoring wells in January 1989 and subsequent depth-to-water measurements collected from the monitoring wells, groundwater at the site is perched and confined to the shallow fill material that overlies the continuous clay unit. The depth to perched groundwater varies across the site, from a depth approximately 5 feet below ground surface on the General Die Casting property to a depth approximately 1 foot below ground surface on the Central Steel & Wire property. This difference in depth to groundwater across the site is attributed to the ground-surface elevation difference

between the two properties. The Central Steel & Wire property is approximately 4 to 5 feet lower in elevation than the General Die Casting property.

ARCADIS Geraghty & Miller evaluated the perched groundwater-flow conditions and hydraulic conductivity within this perched groundwater zone, and summaries of the site perched groundwater-flow conditions and hydraulic conductivity are presented below.

Perched Groundwater-flow Conditions

ARCADIS Geraghty & Miller collected three rounds of depth-to-water measurements at the site after the installation of the monitoring wells; however, a perched groundwater-flow gradient and direction could not be identified. The perched groundwater-elevation measurements obtained in December 1998 and March 1999 are representative of these data collection activities and are presented on Figures 8 and 9, respectively. As shown on these figures, there is no significant perched groundwater gradient trend at the site; perched groundwater does not appear to flow in any defined direction; and perched groundwater elevation contours cannot be inferred. Thus, the perched groundwater is believed to be relatively stagnant, remaining at the approximate location where the water infiltrated into the subsurface.

Hydraulic Conductivity

In February 1998, ARCADIS Geraghty & Miller completed rising-head hydraulic conductivity tests at Monitoring Wells MW-2 and MW-6 (see Figure 9). A Hermit data logger and down-hole pressure transducer were used during these slug tests to record the recharge of the monitoring well after a volume of water had been removed. The Geraghty & Miller AQTESOLV computer program was utilized to analyze the perched groundwater-recharge data, using the Bouwer-Rice method. The hydraulic conductivity of the saturated soils in the vicinity of Monitoring Well MW-2 was calculated to be 1.24 E 10^{-4} feet per minute (ft/min) or 65 ft/year, and the hydraulic conductivity of the saturated soils in the vicinity of Monitoring Well MW-6 was calculated to be 8.98 E 10^{-4} ft/min or 470 ft/year. These results indicate the fill material exhibits hydraulic characteristics similar to that of a moderately permeable silt or glacial till.

Regulatory Cleanup Criteria Evaluation

Due to modifications of the Michigan regulatory cleanup standards that have occurred throughout the completion of site data collection activities, ARCADIS Geraghty & Miller completed a comprehensive analysis of the historic site data with respect to the current groundwater and soil cleanup criteria promulgated under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

To determine the applicable MDEQ cleanup criteria, it is necessary to complete an evaluation of the relevant exposure pathways and receptors specific to the site. ARCADIS Geraghty & Miller initially completed a potential migration pathway and receptor analysis for the site in 1998, and a summary of the findings was presented in the Phase II Remedial Investigation Report. ARCADIS Geraghty & Miller screened the results of that potential receptor evaluation against all current MDEQ groundwater and soil cleanup criteria to determine the relevant exposure pathways. The results of this screening are discussed below and have been subdivided into a discussion of the regulatory groundwater cleanup criteria and a discussion of the regulatory soil cleanup criteria. A general description of the criterion purpose, as presented in the MDEQ Guidance Manual, is presented beneath each MDEQ Cleanup Criterion heading along with a discussion the criterion screening against the site conditions.

Regulatory Groundwater Cleanup Criteria Screen

Drinking Water Criteria (Residential, Commercial, and Industrial Criteria)

The MDEQ Drinking Water Criteria identify threshold concentrations in drinking water determined to be safe for long-term, daily residential consumption. For select hazardous substances, the MDEQ also considered adverse aesthetic impacts during the establishment of these criteria. The MDEQ indicates that the drinking water pathway is relevant for all groundwater present in an aquifer, and the drinking water criteria are applicable unless drinking water use from the aquifer is prohibited by enforceable land use restrictions, a restrictive covenant, or a regulatory approved institutional control.

It is improbable, based on the geology of the area and the low hydraulic conductivity of the shallow saturated fill at the site, that this unit would be classified as an aquifer or used for a drinking water resource. In addition, a public drinking water supply is available to the residents in the site area. The public drinking water supply is operated by the Detroit Water & Sewer Department, which obtains its public water supply from

several surface-water intakes located in Lake St. Clair and the Detroit River. Based on this evaluation, the drinking water exposure pathway and criteria are not relevant for this site.

Groundwater/Surface-water Interface Criteria

The MDEQ Generic Groundwater/Surface-water Interface (GSI) Criteria identify threshold groundwater concentrations that are protective of a receiving surface water body. The MDEQ states the GSI pathway is relevant to all land uses if there is a hydraulic connection between the groundwater and a surface water body, and the MDEQ identifies several factors to consider when evaluating whether a hydraulic connection exists at a site (i.e., proximity to surface water body, direction of groundwater movement, presence of artificial structures that could alter hydraulic pathways).

ARCADIS Geraghty & Miller evaluated the potential for site perched groundwater impacts to enter surface-water receptors. The site data indicate the impacts are limited to the General Die Casting and Central Steel & Wire properties, and surface water bodies were not identified within a 1-mile radius of the properties. Thus, there is no direct hydraulic connection to a surface water body within the area of perched groundwater impacts, and the GSI exposure pathway and criteria are not relevant for this site.

Groundwater Volatilization to Indoor Air Inhalation Criteria (Residential, Commercial, and Industrial)

The MDEQ established the Groundwater Volatilization to Indoor Air Inhalation criteria (GVIIC) to identify threshold groundwater concentrations that would protect building occupants from inhaling indoor air concentrations (vapors) that may cause adverse health effects. The MDEQ has identified this pathway to be relevant for both groundwater in an aquifer and groundwater not in an aquifer. The MDEQ states generic GVIIC cannot be used if the highest groundwater table elevation of a contaminated saturated zone is less than 3 meters below ground surface; however, professional judgment can be used to determine if this pathway is relevant for that shallow groundwater.

Potential inhalation of chemical compounds from the perched groundwater at the site is unlikely to occur because of the non-volatile nature of the COCs. Inhalation of hexavalent chromium or cyanide gas from the crystalline deposits formerly observed

in the area of the foundation wall water seeps at the Central Steel & Wire property was identified as a potential pathway; however, sealing the seeps with hydraulic cement and a masonry sealant has eliminated this pathway. In addition, the site building is scheduled for demolition. Thus, groundwater volatilization and the GVIIC are not relevant for this site.

Groundwater Acute Inhalation Toxicity Screening Levels

The MDEQ established acute inhalation toxicity screening levels to identify volatile COC groundwater concentrations that would cause unacceptable air concentrations and acute inhalation toxicity within enclosed spaces. These screening levels were developed using National Institute for Occupational Safety and Health (NIOSH) short-term exposure limits (STEL) that are defined as 15-minute time-weighted average exposures that should not be exceeded at any time during a workday.

As stated above, groundwater volatilization is not a relevant exposure pathway at this site. Thus, this is not a relevant screening criteria for this site.

Groundwater Contact Criteria

The MDEQ Groundwater Contact Criteria identifies threshold groundwater concentrations that are protective of adverse health effects caused by dermal exposures to hazardous substances in groundwater, such as could be experienced by workers in subsurface excavations. The MDEQ states this pathway is relevant for all land uses unless the depth to groundwater exceeds the depth at which utilities exist and the depth at which subsurface work is likely to occur, and/or the local groundwater yield to excavations is so low that seepage and collection into the excavation is insignificant, resulting in insignificant exposure potential.

Due to the shallow depth-to-perched groundwater at the site, potential direct contact with perched groundwater impacts at the site is possible. Thus, the groundwater direct contact exposure pathway and Groundwater Contact Criteria are believed to be relevant for this site.

Groundwater Screening Levels for Flammability and Explosivity

The MDEQ developed groundwater screening levels for flammability and explosivity to identify groundwater concentrations that would be protective against the physical

hazards of flammability and explosivity. The MDEQ indicates this pathway to be relevant for all land uses.

Because of the non-volatile nature of the site COCs, this criteria is not relevant for this site. An MDEQ Flammability and Explosivity Screening Level for cyanide has not been developed.

Summary of Groundwater Criteria Screening

Based on an evaluation of site conditions and site-specific potential exposure pathway analysis, the following is the only MDEQ Groundwater Cleanup Criterion believed to be relevant for this site:

- Groundwater Contact Criteria.

Regulatory Soil Cleanup Criteria Screen

Statewide Default Soil Background Levels

These levels identify concentrations of inorganic hazardous substances in soils that can be used throughout the state to determine if on-site concentrations are representative of background conditions, as defined in Part 201. In addition to these Statewide Default Levels, the MDEQ allows alternative site-specific or regional background values to be calculated using specified techniques (i.e., the MDEQ *Verification of Soil Remediation Guidance Document* or the mean plus three times the standard deviation).

Site-specific background soil samples were previously collected from properties to the northwest, north, and south of the General Die Casting site and analyzed for metals and cyanide. Therefore, although the Statewide Default Levels are an appropriate screening criteria for the site, the available site-specific calculated background concentrations should be used to determine local background conditions.

Soil Criteria Protective of Drinking Water (Residential, Commercial, and Industrial)

The MDEQ established this criteria to identify threshold soil concentrations that are not expected to leach and impact groundwater at levels greater than the MDEQ Drinking Water Criteria. The MDEQ identifies this criteria as a relevant pathway at any facility where groundwater is in an aquifer or where groundwater is not in an aquifer but transports a hazardous substance into an aquifer.

As stated earlier, it is improbable that the shallow saturated fill unit at the site would be classified as an aquifer. In addition, the silty clay unit underlying the saturated fill material is believed to be an effective confining unit that prevents the downward vertical migration of impacted perched groundwater at the site. Thus, this exposure pathway and criteria are not relevant for this site.

Soil Criteria Protective of the Groundwater/Surface-water Interface

This criteria identifies threshold soil concentrations that are not expected to leach and impact groundwater at levels greater than the corresponding GSI criteria. The MDEQ states the soil leaching pathway for GSI protection is relevant for all land uses if there is a hydraulic connection between the groundwater and a surface water body.

Because there is no direct hydraulic connection between impacted perched groundwater at the site and a surface water body, this exposure pathway and criteria are not relevant for the site.

Soil Criteria Protective for Groundwater Contact

The MDEQ established the Soil Criteria Protective for Groundwater Contact to identify threshold soil concentrations that are not expected to impact groundwater at levels greater than the Groundwater Contract Criteria. The MDEQ states this pathway is relevant for all land uses unless the depth to groundwater exceeds the depth at which utilities exist and the depth at which subsurface work is likely to occur and/or the local groundwater yield to excavations is so low that seepage and collection into the excavation is insignificant, resulting in insignificant exposure potential.

Due to the shallow depth to perched groundwater at this site, this exposure pathway and criteria are believed to be relevant.

Soil Volatilization to Indoor Air Inhalation Criteria (Residential, Commercial, and Industrial)

Similar to the GVIIC, the MDEQ established the Soil Volatilization to Indoor Air Inhalation Criteria (SVIIC) to identify soil concentrations that would protect building occupants from indoor air concentrations that may cause adverse health effects. The MDEQ has identified this pathway to be relevant only for volatile hazardous substances. In addition, the MDEQ states generic SVIIC cannot be used if a structure is present that uses materials at or below ground surface, such as soil or stone floors or

walls, that do not provide an equivalent limitation on vapor infiltration as is provided by poured or concrete block floors and walls.

The site COCs are non-volatile compounds. In the event that vapors would be present, however, the sealing of the Central Steel & Wire basement wall with masonry waterproofing material has limited vapor infiltration, and the demolition of the site building will eliminate this exposure pathway. Thus, the SVIIC is not a relevant criteria at this site, and this criterion has been eliminated from further evaluation.

Soil Direct Contact Criteria (Residential, Commercial, and Industrial)

This criteria identifies threshold soil concentrations that the MDEQ has determined to be protective against adverse health effects due to long-term ingestion of and dermal exposure to impacted soil.

Exposure to impacted soil is a relevant pathway at this site due to the presence of unpaved areas and the shallow, impacted fill material at the site. Thus, this criteria is believed to be relevant to the site.

Summary of Soil Criteria Screening

Based on an evaluation of site conditions and the site-specific potential exposure pathway analysis, the following are the only MDEQ soil screening criteria believed to be relevant for this site:

- Statewide Default or Site-specific Soil Background Levels.
- Soil Criteria Protective of Groundwater Contact.
- Soil Direct Contact Criteria.

Site Environmental-quality Summary

Based on the results of the regulatory screening evaluation presented above, ARCADIS Geraghty & Miller compared the site perched groundwater-quality and soil-quality data to the MDEQ Groundwater Contact Criteria , the MDEQ default or calculated site-specific background levels, Soil Criteria Protective of Groundwater Contact, and Soil Direct Contact Criteria to determine the remedial action objectives.

Perched Groundwater-quality Summary

A summary of the site perched groundwater-quality analytical results from the January and December 1998 monitoring well sampling events is presented in Table 1. As indicated in the table, the only compound that exceeded the MDEQ Groundwater Contact Criteria was cyanide. In addition, the cyanide Groundwater Contact Criteria exceedance (greater than 650,000 micrograms per liter [ug/L]) was only reported at one location, Monitoring Well MW-2. The cyanide analytical results are shown on Figure 10. The area with the exceedance of the Groundwater Contact Criteria for cyanide is also shown on Figure 10. Detectable concentrations of cyanide were only reported in Monitoring Wells MW-1, MW-2, MW-5, and MW-6. In addition, detectable levels of cyanide were not reported in Monitoring Wells MW-3 and MW-4 during the December 1998 sampling event.

A summary of the perched groundwater-quality data obtained during the March 1999 Geoprobe investigation is presented in Table 2. The cyanide concentration reported for the sample collected from Boring GP-4 at a depth 6 to 7 feet below ground surface was the only reported exceedance of the MDEQ Groundwater Contact Criteria. Boring GP-4 is located immediately east of Monitoring Well MW-2 (see Figure 7). In addition, it should be noted that low cyanide concentrations were reported for the perched groundwater samples collected from the eastern end of the investigation, and the cyanide concentrations reported immediately south of the General Die Casting building were generally one order of magnitude below the cyanide concentrations reported adjacent to the Central Steel & Wire building. The lower cyanide concentrations reported adjacent to the General Die Casting building are likely due to the former soil excavation activities completed in that area (see Figure 3) that effectively removed cyanide-impacted source material. Therefore, the area of perched groundwater impacts above the MDEQ Groundwater Contact Criteria appear to be relatively small and isolated to the area beneath the northern driveway of the Central Steel & Wire property (see Figure 10).

Soil-quality Summary

The soil-quality analytical results from the extensive TOXICO subsurface investigations are included in the 1994 TOXICO Report of Soil Investigations and Preliminary Remedial Plan report and have not been reproduced in this document, but a discussion of the results has been included when appropriate. The analytical results from the ARCADIS Geraghty & Miller soil-quality investigations are provided in this report. These samples were collected from areas throughout the entire General Die

Casting site and the northern driveway of the Central Steel & Wire property. ARCADIS Geraghty & Miller did screen all historic soil-quality data against the current and relevant MDEQ cleanup criteria to determine remedial objectives.

The soil-quality analytical data reported for the soil samples collected during the installation of the site monitoring wells in January 1998 is provided in Table 3, and the analytical results from the soil samples collected during the March 1999 investigation in the Central Steel & Wire northern driveway are presented in Table 4. The applicable and relevant MDEQ soil cleanup criteria have also been included in these tables for comparison purposes.

As shown in Table 3, several metals concentrations reported in monitoring well boring samples exceed the MDEQ Statewide Default Background Levels (arsenic, barium, chromium, copper, lead, and zinc); however, only the lead concentration reported at Monitoring Well MW-6 (430,000 micrograms per kilogram [ug/kg]) was above the MDEQ Soil Direct Contact Criterion of 400,000 ug/kg. This sample was collected from the eastern portion of the General Die Casting site, outside the former zinc die casting and electroplating operations. The reported 430,000 ug/kg lead concentration is below the site-specific calculated background level of 865,000 ug/kg for lead. In addition, the MDEQ has proposed a draft Industrial Soil Direct Contact Criterion for lead at 900,000 ug/kg that would be applicable for the General Die Casting site. Thus, remediation of the metals at these locations is not warranted. The extensive soil-quality data obtained by TOXICO, however, reports arsenic concentrations above the MDEQ Soil Direct Contact Criterion at Soil Borings SB-1, SB-3, and SB-6, within the eastern portion of the site (see Figure 4). In addition, an elevated lead concentration was reported at Soil Boring SB-6, above the current and proposed MDEQ Direct Contact Criterion. Therefore, a direct contact barrier is recommended in the eastern portion of the site.

Detectable levels of cyanide were not reported in the soil samples collected from the borings for Monitoring Wells MW-3, MW-5, and MW-6. Cyanide impacts were reported from the borings for Monitoring Wells MW-1, MW-2, and MW-4; however, the total cyanide concentrations reported at Monitoring Well MW-2 (280,000 ug/kg) was the only reported concentration above the Soil Criteria Protective of Groundwater Contact and the Soil Direct Contact Criteria, both 250,000 ug/kg. As shown on Figure 10, the location of this exceedance of the MDEQ soil cleanup criteria corresponds to the localized area of perched groundwater impacts above the Direct Contact Criteria. In addition, several soil samples obtained beneath the General Die Casting floor by

TOXICO had reported concentrations of cyanide in exceedance of the MDEQ cleanup criteria.

Analytical results of the soil samples collected during the March 1999 Geoprobe investigation on the Central Steel & Wire property are shown in Table 4. At each of the 20 Geoprobe borings locations, soil samples were collected from 0 to 1 foot, 1 to 2 feet, and 2 to 3 feet below ground surface. Detectable concentrations of cyanide were reported for at least one of the three soil samples collected from each soil boring except Borings GP-9, GP-11, GP-12, and GP-19, which are located at or near the eastern and western ends of the investigated area. In general, the majority of cyanide impacts were reported at depths 2 to 3 feet below ground surface, with the highest concentrations reported adjacent to the Central Steel & Wire building rather than the General Die Casting building. As stated earlier, this is likely due to the previous removal of impacted soil immediately south of the General Die Casting building. The only locations where the reported cyanide concentrations exceed the MDEQ soil cleanup criteria (250,000 ug/kg) were Borings GP-2 and GP-3 at depths 2 to 3 feet below ground surface. Borings GP-2 and GP-3 are located adjacent to, and west of, Monitoring Well MW-2, consistent with the location of the documented highest cyanide concentrations in perched groundwater.

Environmental-quality Summary

Based on the results of the ARCADIS Geraghty & Miller investigations, the area of perched groundwater impacts requiring remedial action is localized beneath the Central Steel & Wire northern driveway, within the vicinity of Monitoring Well MW-2. Cyanide-impacted soils requiring remedial action are also located within the Central Steel & Wire northern driveway.

An evaluation of the historic site data collected by TOXICO indicates soil-quality exceedances of the MDEQ Direct Contact Criteria beneath the General Die Casting building and within the eastern portion of the site. Thus, a direct contact barrier across the General Die Casting site is recommended.

Remedial Technology Evaluation

A comprehensive evaluation of potential remedial technologies was completed for this site, although the majority were eliminated from further consideration due to the lack of volatile COCs and only localized site areas of cyanide concentrations above the

regulatory cleanup criteria. A general description of the remedial technologies retained for evaluation, specific to perched groundwater and soil, is provided below.

Perched Groundwater

- Institutional Controls: requires a Restrictive Covenant or similarly restrictive clause prohibiting the use of site groundwater, and this must be recorded with the property deed.

- Site-wide Natural Attenuation: requires demonstration that natural processes (adsorption, dispersion, diffusion, biodegradation) are effectively stabilizing or reducing the dissolved-phase constituent plume.

- Biotreatment: enhances natural biodegradation activity through injection of oxygen and/or other nutrients required by microorganisms below the water table; can cause destruction rather than the phase transfer of constituents or, in the case of dissolved metals treatment, can cause precipitation to an insoluble, less-toxic form of the metal.

- Perched Groundwater Containment: prevents off-site migration of dissolved-phase constituents through the installation of an impermeable hydraulic barrier.

- Perched Groundwater Extraction: prevents off-site migration of dissolved-phase constituents through extraction and the subsequent treatment of perched groundwater; generally, a long-term remedial option.

Soils

- Institutional Controls: requires a Restrictive Covenant or similarly restrictive clause prohibiting the use of site soils, and this must be recorded with the property deed.

- Direct Contact Barrier Cap: placement of a barrier over impacted soils to eliminate direct contact hazard and prevent erosion of impacted surface soils. In addition, a direct contact barrier reduces infiltration of surface water, thereby significantly reducing potential contaminant leaching to perched groundwater.

- Biotreatment: enhances natural biodegradation activity through injection of oxygen and/or other nutrients required by microorganisms into the subsurface; can cause

destruction rather than the phase transfer of constituents or, in the case of dissolved metals treatment, can cause precipitation to an insoluble, less-toxic form of the metal.

- Excavation: off-site removal of impacted soils at or above the water table; excavation of saturated soils possible but requires dewatering/depression of water table during removal activities; generally useful for localized areas of elevated impacts.

Because of the pending reconstruction of the northern Central Steel & Wire driveway that will require excavation within the area exhibiting the highest soil and perched groundwater concentrations, in-situ remedial technologies such as natural attenuation and biotreatment, although initially evaluated, were not considered practical due to the generally longer time frame associated with achieving cleanup objectives. In addition, the use of Institutional Controls is not acceptable to the Central Steel & Wire Company.

Thus, based on an evaluation of the technical merits and site applicability of each of the remedial technologies discussed above, two potentially viable and cost-effective conceptual remedial alternatives were assembled as appropriate remedial technologies for this site:

Alternative 1: Site-wide Direct Contact Barrier on General Die Casting property with Building Foundation Retained, Hydraulic Barrier along General Die Casting Southern Boundary, Source Excavation at Central Steel & Wire Northern Driveway, and Perched Groundwater Monitoring (see Figure 11).

Alternative 2: Site-wide Direct Contact Barrier on General Die Casting property with Building Foundation Removed, Hydraulic Barrier along General Die Casting Southern Boundary, Source Excavation at Central Steel & Wire Northern Driveway, and Perched Groundwater Monitoring (see Figure 12).

Analysis of Remedial Alternatives

The remedial alternatives were evaluated based on short-term and long-term effectiveness, site implementability, and cost. As indicated above, both remedial alternatives include the excavation and off-site disposal of impacted soils and perched

groundwater at the Central Steel & Wire property. This is a necessary component because of the driveway reconstruction activities to be completed later this year. In addition, both remedial alternatives include utilizing a direct contact barrier cap over the entire General Die Casting site and a hydraulic barrier along the southern General Die Casting property boundary, as well as the implementation of a perched groundwater monitoring program.

The difference between the two remedial alternatives is the incorporation of the General Die Casting site building foundation as part of the direct contact barrier. The General Die Casting site building is scheduled for demolition because of its poor structural condition, and the demolition activities will likely be completed in conjunction with site remediation. Therefore, under Remedial Alternative #1, the building foundation would be left in-place and serve as a direct contact barrier preventing potential exposure to impacts beneath the building. The building foundation would be excavated under Remedial Alternative #2.

A discussion of each of the remedial alternative elements is included below, and the estimated costs to implement Remedial Alternatives #1 and #2 are presented in Tables 5 and 6, respectively. The cost estimate for the building demolition was not developed by ARCADIS Geraghty & Miller and was provided by representatives of General Die Casting.

Site-wide Direct Contact Barrier on the General Die Casting Property

To prevent unacceptable exposures to potentially impacted soils beneath the General Die Casting site, as well as protection from infiltration, a direct contact barrier will be placed over the site after the General Die Casting building has been demolished.

Under Remedial Alternative #1, the concrete building foundation will be left in place to act as the direct contact barrier. Any areas which need filling after the demolition activities on the site (i.e., former plating line pits and sumps) will be filled with concrete to the existing elevation of the concrete foundation. The areas of the site outside of the building foundation will have an asphalt cover placed over them.

Under Remedial Alternative #2, the concrete building footprint will be excavated during building demolition activities. The direct contact barrier will consist of the placement of 2 feet of soil within the area of the former building footprint, and the placement of an asphalt surface cover across the entire site.

A discussion of the remaining elements that are common for each remedial alternative is provided below.

Hydraulic Barrier along General Die Casting Southern Boundary

Slurry walls, various soil admixture walls, grout curtains, and structural walls can be used as hydraulic barriers to reduce the migration of perched groundwater. To function properly, the barriers require anchorage or sealing into a relatively impervious subsurface unit, such as bedrock or clay, and may demonstrate varying efficiencies with respect to flow modification and chemical compatibility. Two options for the composition of the hydraulic barrier were considered during this FFS, a sheet pile wall and a slurry wall.

Under either scenario, the wall will be installed parallel to the southern side of the General Die Casting building between the driveway and building. The existing small fence parallel to the driveway will need to be removed to install the wall. It is assumed that the wall will be approximately 400 feet long and will extend in both the eastern and western directions 50 feet from the building edges. The hydraulic barrier wall will extend to a depth 10 to 12 feet where it will be keyed into the clay confining layer. The hydraulic barrier wall will be installed prior to the excavation of the Central Steel & Wire northern driveway to reduce perched groundwater infiltration into the construction area. As a long-term remedial component, it will serve to minimize the off-site migration of any residual contamination below the General Die Casting building.

Based on the cost comparison of the two hydraulic barriers considered, the sheet pile hydraulic barrier was retained within both Remedial Alternatives #1 and #2.

Source Excavation at Central Steel & Wire Northern Driveway

Several treatment and disposal options for the excavated soils and perched groundwater were considered during this FFS. On-site staging and biotreatment of the excavated cyanide-impacted soils and perched groundwater were considered, rather than off-site disposal. However, this would require an approximately 3- to 6-month biotreatability pilot study prior to full-scale implementation, and the biotreatability of cyanide-impacted soils is not yet a proven technology. Therefore, due to the lengthy time frame potentially required to complete remediation, the space-requirements associated with this option, and the lack of certainty in its success, on-site ex-situ biotreatment of the excavated soils and perched groundwater was not further

evaluated. In addition, the placement of the excavated soils on top of the General Die Casting building foundation followed by the installation of an appropriate direct contact cover was also considered. This option, however, would require the placement of an impermeable, synthetic liner and an additional 2 to 3 feet of soil cover over the excavated soils (on top of the building foundation) that would result in a significant grade increase at the site. Thus, because of the impracticability of this option, it was eliminated from further consideration. Therefore, the source removal activities within both remedial alternatives consist of excavation and off-site disposal as outlined below.

Prior to the start of excavation activities, a Geoprobe unit will be mobilized to the site to take samples in various parts of the driveway. These samples will be composited and submitted for a Toxicity Characteristic Leaching Procedure (TCLP) analysis, per landfill disposal characterization requirements. This sample will be submitted and analyzed prior to commencement of excavation activities to ensure acceptance of the soils by the landfill.

The driveway from Mt. Elliott to the edge of the Central Steel & Wire building will be removed to a depth 3 feet below ground surface, as required for the installation of a new concrete drive. This area is approximately 30 feet wide by 300 feet long, and approximately 1,000 cubic yards of soil will be removed from this area. Additionally, the area within the vicinity of Monitoring Well MW-2 has reported concentrations of cyanide above MDEQ cleanup criteria at 3 feet below ground surface, and it is likely that these impacts extend below 3 feet. As documented by previous soil boring investigations, the depth to the confining silty clay layer in this area is approximately 6 to 8 feet below ground surface. Therefore, as indicated on Figures 11 and 12, the soil excavation in this area will extend to 8 feet below ground surface.

The excavation will require the removal of Monitoring Wells MW-1 and MW-2. These monitoring wells will be reinstalled after the completion of the new driveway for use in the long-term perched groundwater monitoring program. A storm sewer line currently exists beneath the driveway at an unknown depth. A manhole is located near the eastern edge of the proposed excavation. The manhole will be left undisturbed as the soil is removed around it to a depth of 3 feet. It will be assumed that the top of the sewer line is buried deeper than the proposed excavation and will not pose any problems during the excavation.

Thus, the total volume of soil to be excavated from the Central Steel & Wire northern driveway and disposed off-site as nonhazardous material is approximately 1,600 cubic

yards. The clean soil removed for the driveway renovation will be mixed with the soils in the "hot zone" so that the soil entering the landfill is well mixed and uniform in concentration. During the excavation activities, a single composite sample will be taken from the excavated soils for disposal approval at the BFI landfill in Northville, Michigan.

Given the volume of soil to be removed and assuming the water level in the driveway is approximately 1 foot below ground surface and the soil has a porosity of 30%, the area will have to be dewatered of approximately 85,000 gallons of perched groundwater during the excavation. This volume calculation is the amount of water in the soil at a given time, or one pore volume, and also includes the assumption that water will enter the excavation at a rate of 1,500 gallons/day. Disposal options for the removed water include the municipal publicly owned treatment works (POTW) or an off-site treatment facility. Because of the elevated cyanide concentrations expected in the removed water, it may not be feasible to dispose of the water at a POTW. Therefore, for purposes of this FFS, it has been assumed that the water will be disposed at an off-site treatment facility. In summary, for cost estimating purposes, the following assumptions apply:

- 1,600 cubic yards of nonhazardous soil which is below the MDEQ Direct Contact Criteria will be shipped to the BFI landfill without treatment.
- The excavation will last five days with continuous dewatering required.
- 85,000 gallons of nonhazardous wastewater (generated from dewatering) will be shipped to the City Environmental, Inc. treatment facility.

Soil removal will be conducted by excavating the backfill material and immediately placing it in trucks for delivery to the BFI landfill. Soil in need of drying will be placed on plastic sheeting and mixed with dry soil prior to loading onto trucks. Standard earth-moving equipment will be used for excavation activities. Appropriate health and safety precautions will be employed to protect workers during the excavation activities, and engineering controls will be utilized, as needed, to minimize dust generation. During excavation, it is estimated that water will be encountered at a relatively shallow depth. Using high capacity transfer pumps, dewatering will be conducted concurrently with excavation activities. The water will be pumped into one of three mobile tanks that will be parked on-site. These tanks, commonly referred to as frac tanks, will have a capacity of 18,000 gallons. When each tank nears capacity, a representative sample will be collected and analyzed for total and reactive cyanide on a rush (24-hour turn around time) basis. The analytical results will dictate whether or not the water can be disposed as hazardous or nonhazardous. For the purposes of this

FFS, it is assumed that the water will be mixed well enough to dispose as nonhazardous with a percentage of solids between 5 and 10 percent. A vacuum truck will be used to transport the water from the frac tanks to the treatment facility as needed. Wastewater generated during equipment and personnel decontamination activities will also be pumped into the frac tank. Upon completion of the excavation, the frac tanks will be washed, emptied, and removed from the site.

Per the MDEQ *Verification of Soil Remediation Guidance Document* (April 1994, Revision 1), the following information is presented for confirmatory closure sampling after the soil has been removed from the excavation. The floor and sidewalls of the excavation will be sampled to document soil quality. Nine soil samples will be collected from the floor of the excavation, and an additional 11 samples will be collected from the sidewalls. These samples will be sent under chain of custody to Savannah Laboratories & Environmental Services, Inc. in Savannah, Georgia for the following analyses: VOCs, SVOCs, metals, total cyanide, and amenable cyanide.

Approximately 810 cubic yards of clean backfill material will be required to restore the deep part of the excavation to the level of the driveway subbase. In the other areas between the driveway and the Central Steel & Wire building where a gravel cover currently exists, the gravel will be replaced to the current grade to match current site conditions. Areas where the driveway is to be installed will be backfilled to a depth approximately 3 feet lower than the current elevation to allow for the installation of an engineered driveway subbase below the asphalt drive. The costs for the driveway reconstruction are not included as part of this feasibility study.

Perched Groundwater Monitoring

Perched groundwater monitoring involves scheduled, periodic sampling and analysis of perched groundwater underlying a site to evaluate site conditions after implementation of a remedial technology. Monitoring the perched groundwater will be a valuable component under both remedial alternatives to evaluate perched groundwater-quality. Therefore, after the remedial actions have been completed, a perched groundwater-quality monitoring program will be implemented.

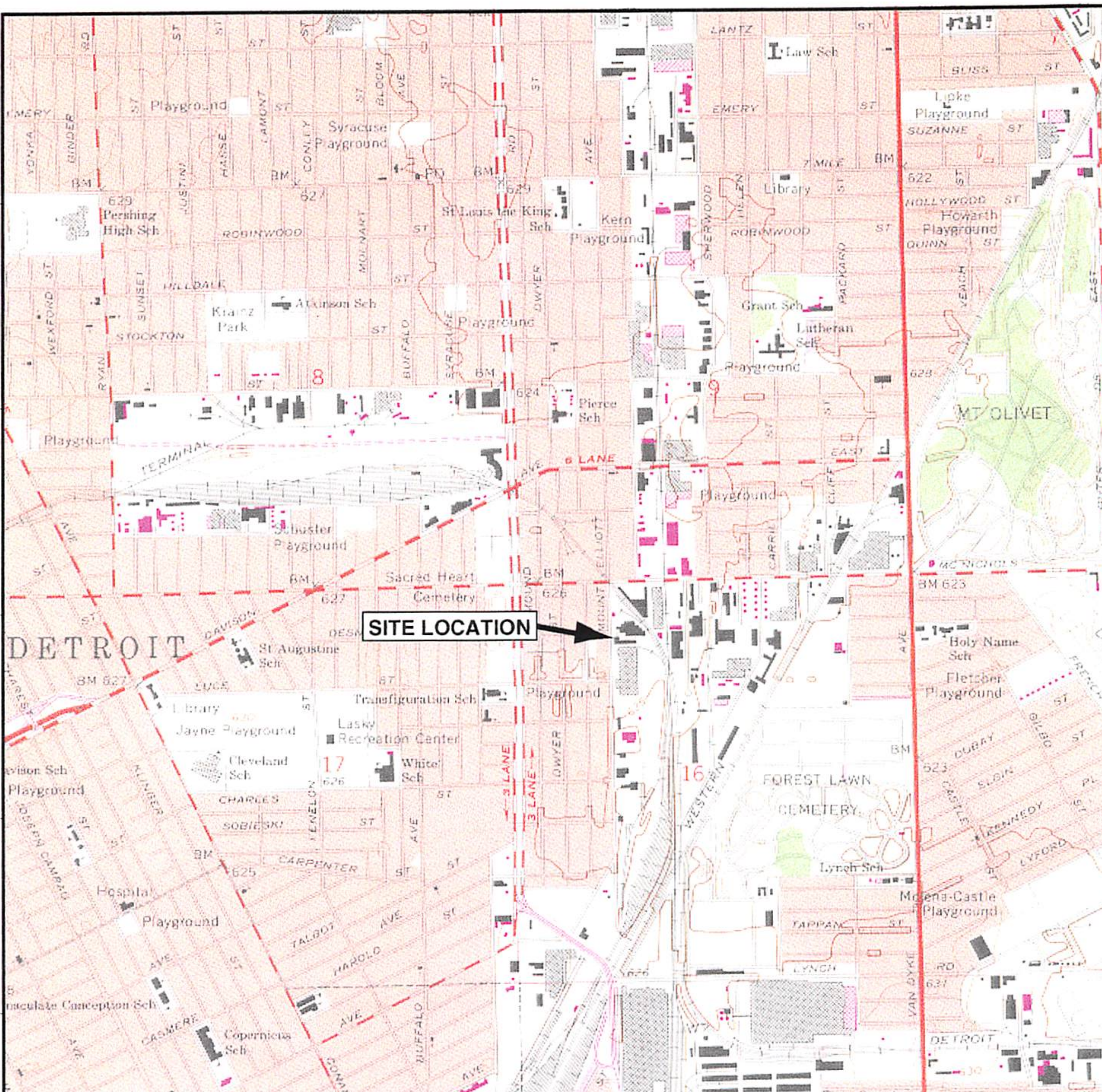
The monitoring program will include sampling and analysis for cyanide, metals, VOCs, and SVOCs from four monitoring wells that were selected to enable the evaluation of perched groundwater quality throughout the site. The four wells selected for the perched groundwater monitoring program include existing Monitoring Well MW-6, replacement Monitoring Wells MW-1 and MW-2, and a proposed new

Monitoring Well MW-7 (see Figures 11 and 12). It is assumed that perched groundwater monitoring would be conducted quarterly for the first year, then annually for years 2 through 30. Water-level monitoring will also be included in the perched groundwater monitoring program to provide necessary data to evaluate perched groundwater flow. Water-level measurements will be collected from the seven site monitoring wells during each sampling event. An annual letter report will be prepared to document perched groundwater analytical results and trends, present water-level data and a corresponding perched groundwater flow map, evaluate whether remedial action objectives have been met, and determine if any modifications to the perched groundwater monitoring program would be appropriate.

For the purposes of the FFS, it will be assumed that the perched groundwater monitoring program will continue for a period of 30 years. However, it is likely perched groundwater remedial goals will be reached and monitoring activities can be discontinued prior to that time.

Recommended Remedial Alternative

The detailed cost estimate to implement Remedial Alternative #1 is provided in Table 5, and the detailed cost estimate to implement Remedial Alternative #2 is provided in Table 6. After evaluating each remedial alternative, ARCADIS Geraghty & Miller recommends the implementation of Remedial Alternative #1: Site-wide Direct Contact Barrier on General Die Casting property with Building Foundation Retained, Sheet Pile Hydraulic Barrier along General Die Casting Southern Boundary, Source Excavation at Central Steel & Wire Northern Driveway, and Perched Groundwater Monitoring (see Figure 11). This is believed to be the most technically feasible and cost-effective option.



SOURCE: USGS 7.5 Minute Topographic Map, HIGHLAND PARK, MICHIGAN Quadrangle 1983

N

0 1000 2000 4000

SCALE IN FEET

ARCADIS
GERAGHTY & MILLER

SITE LOCATION

GENERAL DIE CASTING COMPANY
DETROIT, MICHIGAN

FIGURE
1

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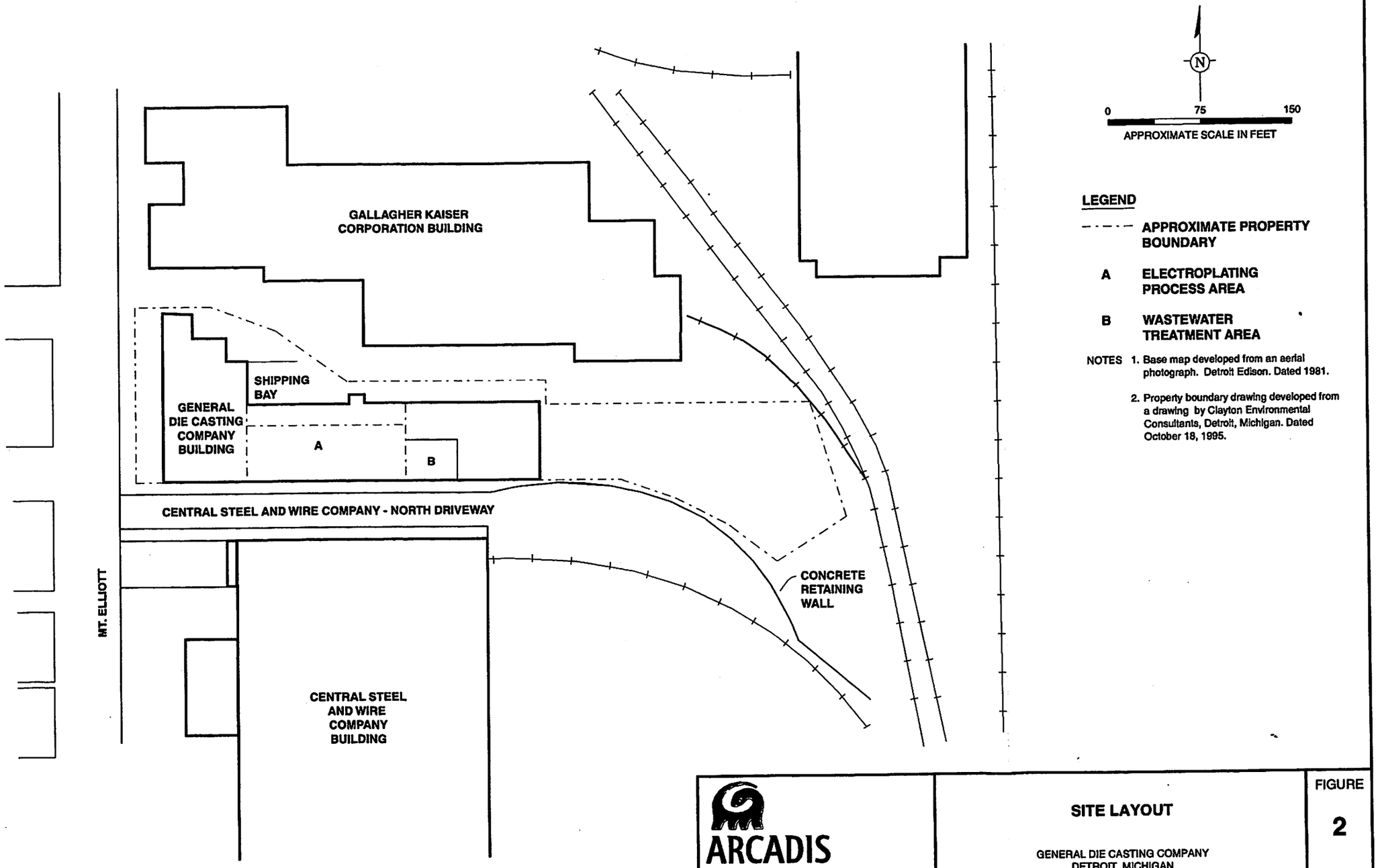

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- A ELECTROPLATING PROCESS AREA
- B WASTEWATER TREATMENT AREA

NOTES
1. Base map developed from an aerial photograph. Detroit Edison. Dated 1981.
2. Property boundary drawing developed from a drawing by Clayton Environmental Consultants, Detroit, Michigan. Dated October 18, 1995.

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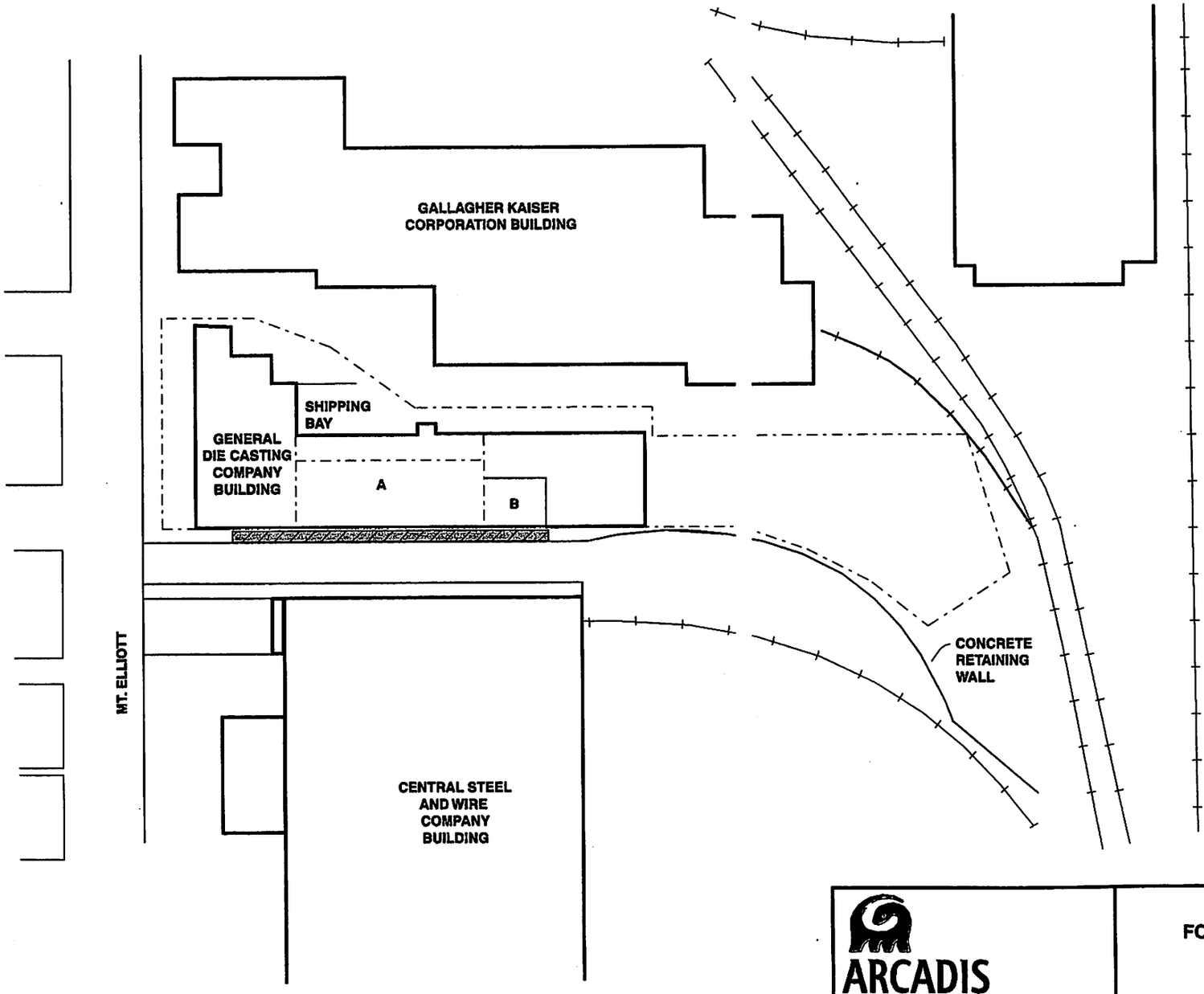
ARCADIS GERAGHTY & MILLER

SITE LAYOUT

GENERAL DIE CASTING COMPANY
DETROIT, MICHIGAN

FIGURE
2



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0 75 150

APPROXIMATE SCALE IN FEET

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- A ELECTROPLATING PROCESS AREA
- B WASTEWATER TREATMENT AREA
- AREA OF PAH-IMPACTED SOIL EXCAVATION

NOTES
1. Base map developed from an aerial photograph. Detroit Edison. Dated 1981.
2. Property boundary drawing developed from a drawing by Clayton Environmental Consultants, Detroit, Michigan. Dated October 18, 1995.

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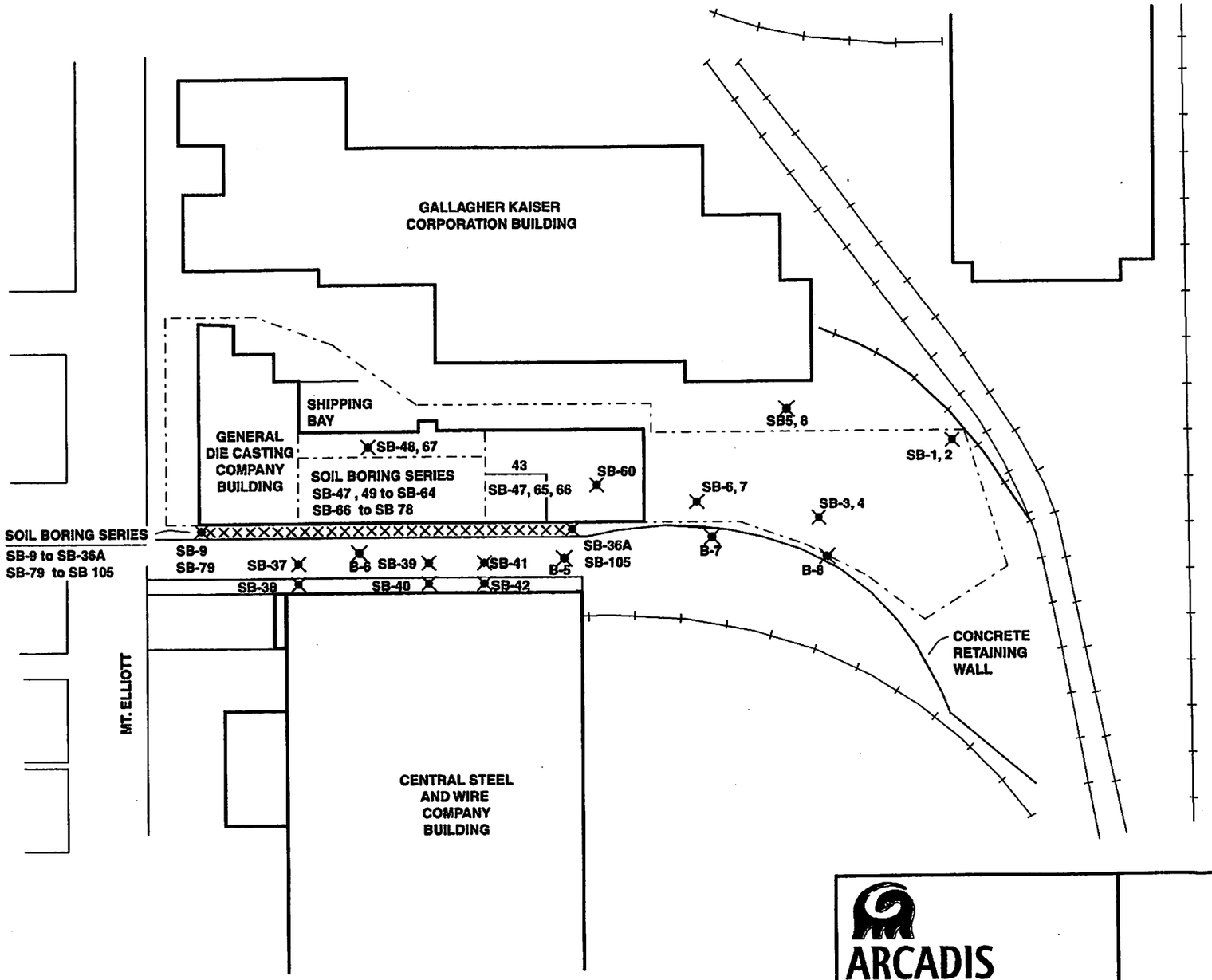
ARCADIS GERAGHTY & MILLER

FORMER EXCAVATION LOCATONS

GENERAL DIE CASTING COMPANY
DETROIT, MICHIGAN

FIGURE
3



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0 75 150

APPROXIMATE SCALE IN FEET

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- SOIL BORING LOCATION
- SOIL BORING DESIGNATION (UNDESIGNATED IN SERIES)

NOTES
1. Base map developed from an aerial photograph. Detroit Edison. Dated 1981.
2. Property boundary drawing developed from a drawing by Clayton Environmental Consultants, Detroit, Michigan. Dated October 18, 1995.
3. All soil boring locations estimated from other drawings/figures contained within site reports.

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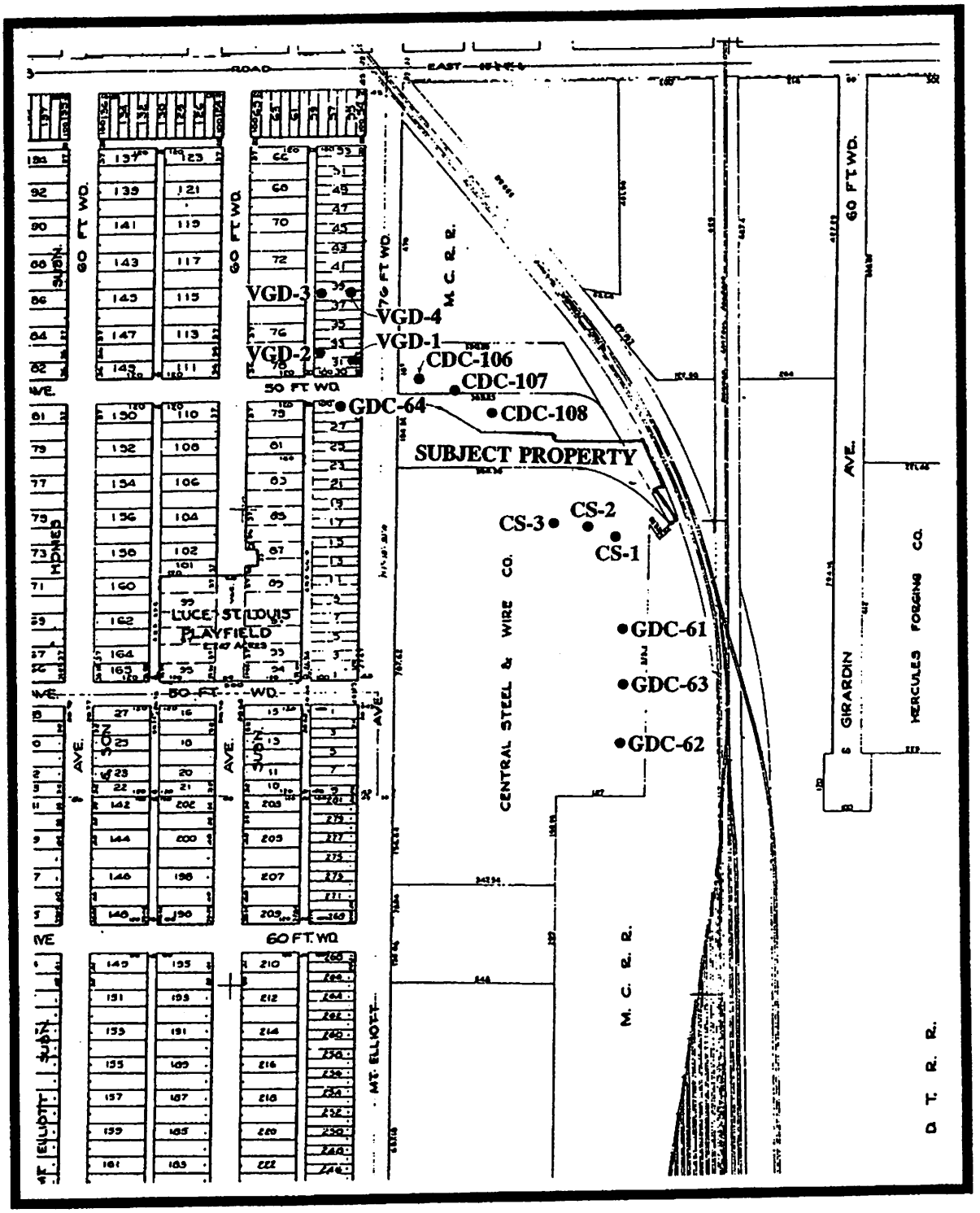
ARCADIS GERAGHTY & MILLER

TOXICO INVESTIGATION
SOIL BORING LOCATIONS

GENERAL DIE CASTING COMPANY
DETROIT, MICHIGAN

FIGURE
4



SOURCE: 1994 TOXICO CORPORATION REPORT

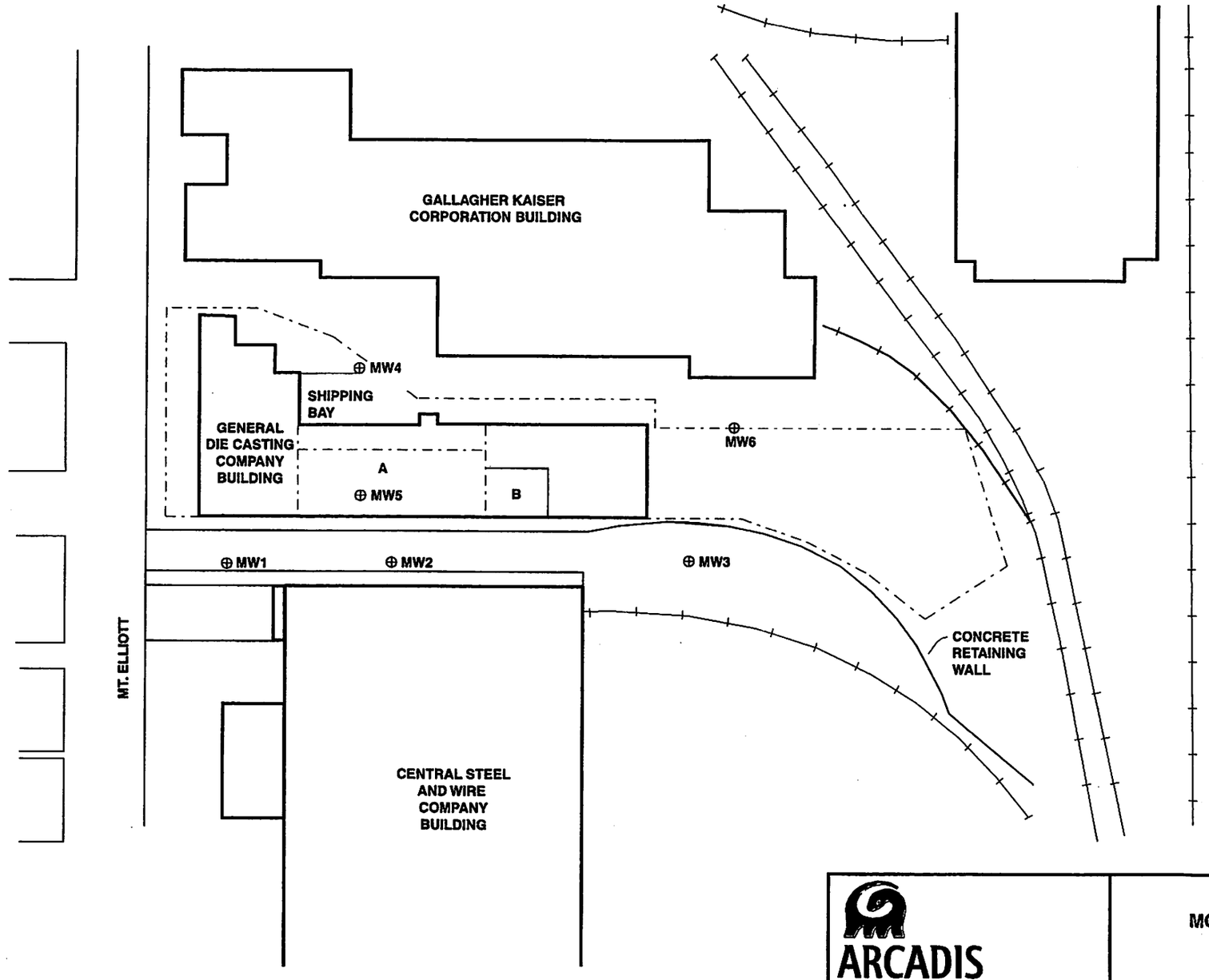
ARCADIS GERAGHTY & MILLER

BACKGROUND SOIL BORING LOCATIONS

GENERAL DIE CASTING COMPANY
DETROIT, MMICHIGAN

FIGURE 5

DRAFTER: ELS | APPROVED: | CHECKED: KPVJV | DRAWING: SOURCE.AI | FILE NO.: GRAPHICS | PN: GRAPH_OHNOVIMI0601 | DWG DATE: 08JUL99



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0 75 150

APPROXIMATE SCALE IN FEET

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- A ELECTROPLATING PROCESS AREA
- B WASTEWATER TREATMENT AREA
- ⊕ MONITORING WELL LOCATION

NOTES
1. Base map developed from an aerial photograph. Detroit Edison. Dated 1981.
2. Property boundary drawing developed from a drawing by Clayton Environmental Consultants, Detroit, Michigan. Dated October 18, 1995.

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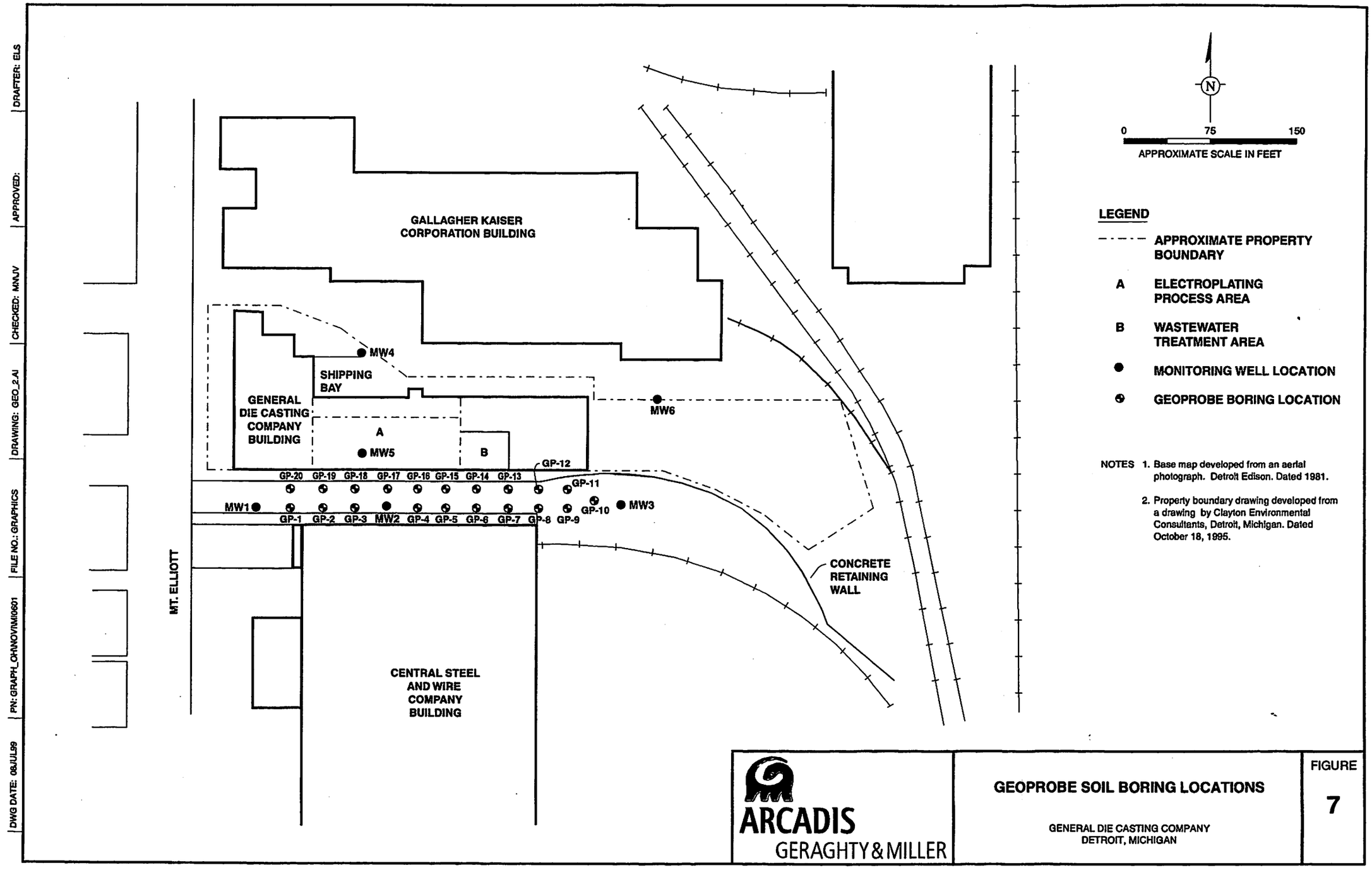
ARCADIS GERAGHTY & MILLER

MONITORING WELL LOCATIONS

GENERAL DIE CASTING COMPANY
DETROIT, MICHIGAN

FIGURE
6

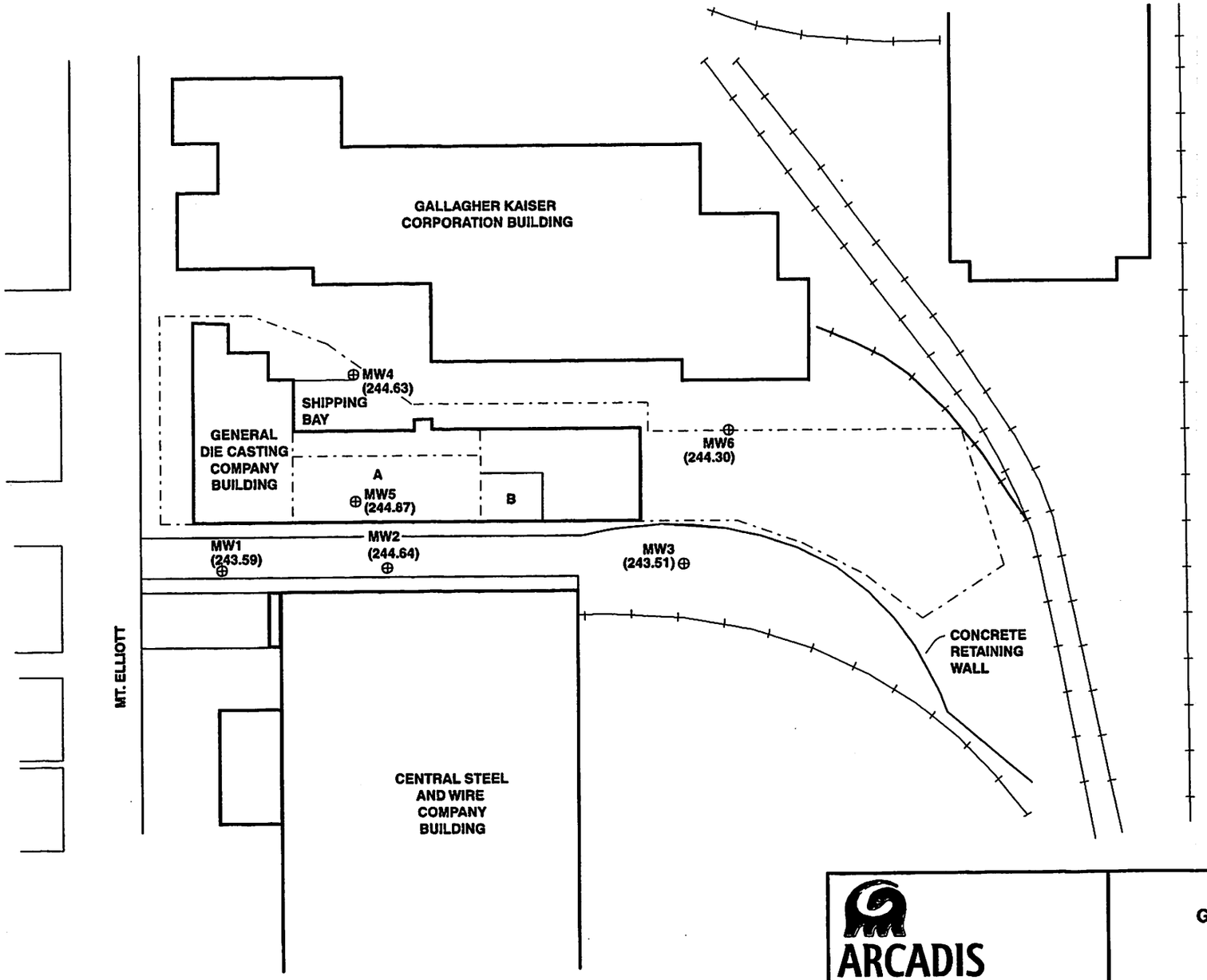


ARCADIS GERAGHTY & MILLER

GEOPROBE SOIL BORING LOCATIONS

GENERAL DIE CASTING COMPANY
DETROIT, MICHIGAN

FIGURE
7



N

0 75 150

APPROXIMATE SCALE IN FEET

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- A — ELECTROPLATING PROCESS AREA
- B — WASTEWATER TREATMENT AREA
- ⊕ — MONITORING WELL LOCATION
- (243.59) — GROUNDWATER ELEVATION BASED ON CITY OF DETROIT DATUM (Measured on December 2, 1998)

NOTES
1. Base map developed from an aerial photograph. Detroit Edison. Dated 1981.
2. Property boundary drawing developed from a drawing by Clayton Environmental Consultants, Detroit, Michigan. Dated October 18, 1995.

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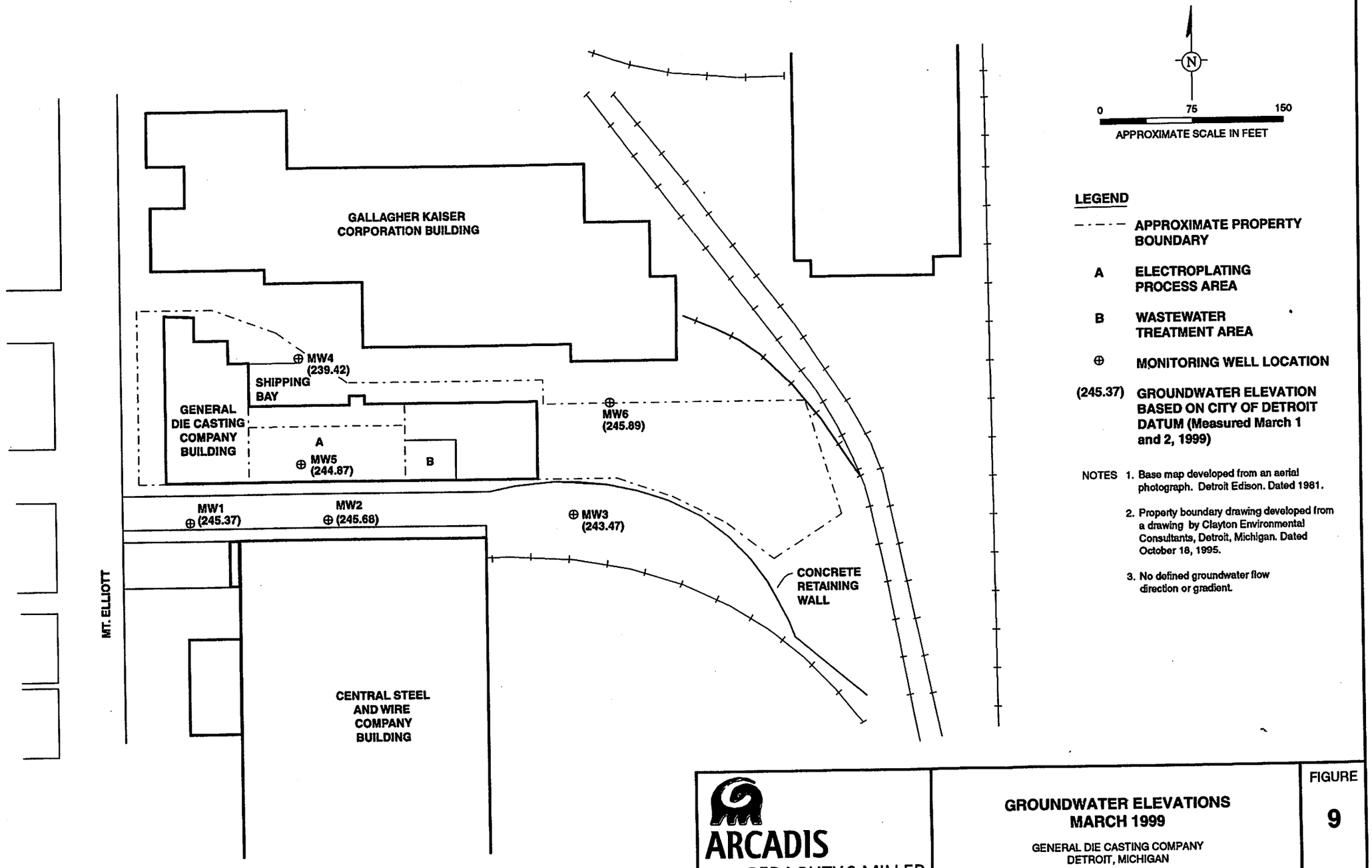
ARCADIS GERAGHTY & MILLER

GROUNDWATER ELEVATIONS
DECEMBER 2, 1998

GENERAL DIE CASTING COMPANY
DETROIT, MICHIGAN

FIGURE
8



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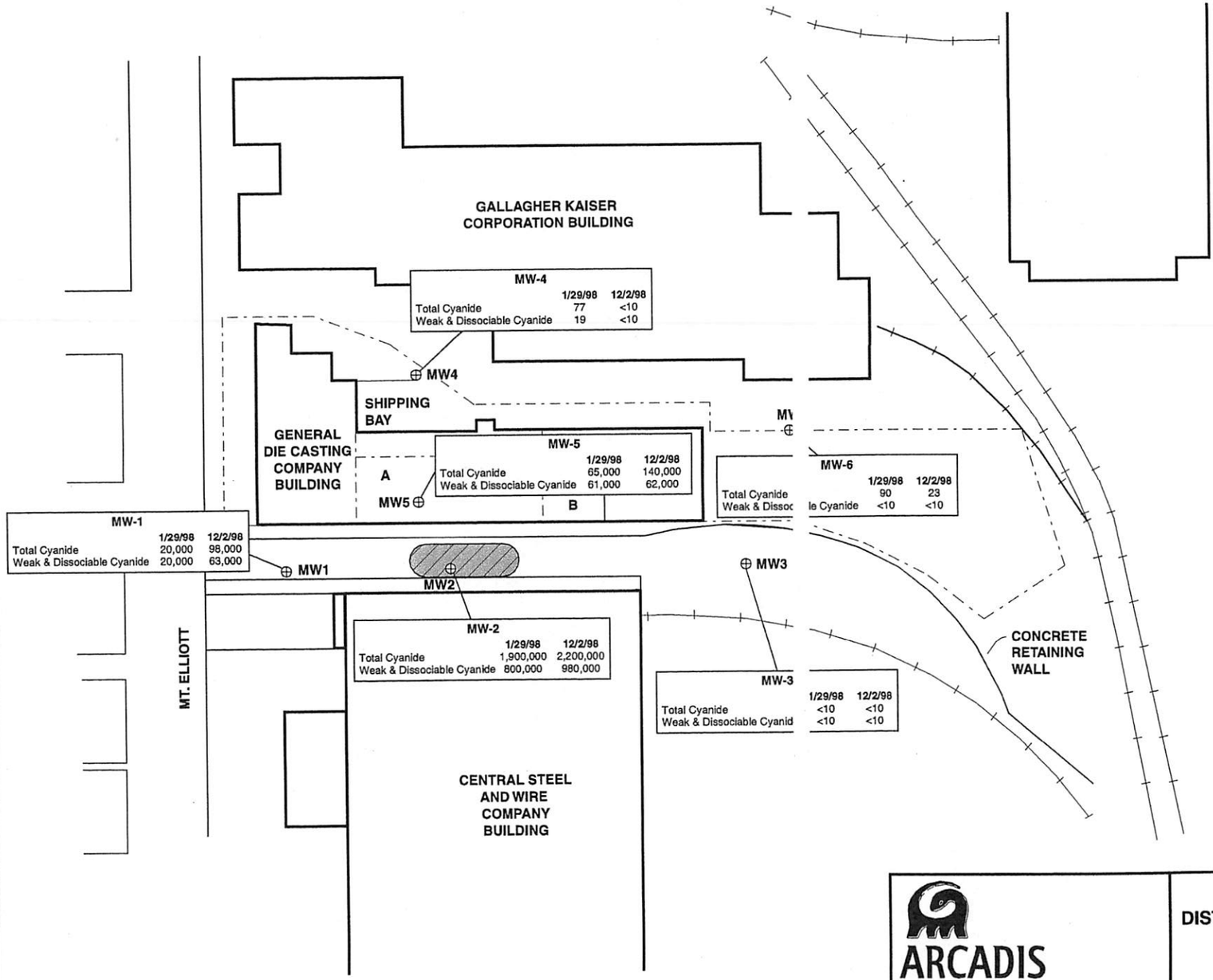
ARCADIS GERAGHTY & MILLER

GROUNDWATER ELEVATIONS MARCH 1999

GENERAL DIE CASTING COMPANY
DETROIT, MICHIGAN

FIGURE 9



LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- A ELECTROPLATING PROCESS AREA
- B WASTEWATER TREATMENT AREA
- ⊕ MONITORING WELL LOCATION
- GROUNDWATER IMPACTS EXCEEDING MDEQ GROUNDWATER CONTACT CRITERION FOR CYANIDE (650,000 µg/L)

NOTES
1. Base map developed from an aerial photograph. Detroit Edison. Dated 1981.
2. Property boundary drawing developed from a drawing by Clayton Environmental Consultants, Detroit, Michigan. Dated October 18, 1995.
3. All concentrations are reported in micrograms per liter (µg/L)

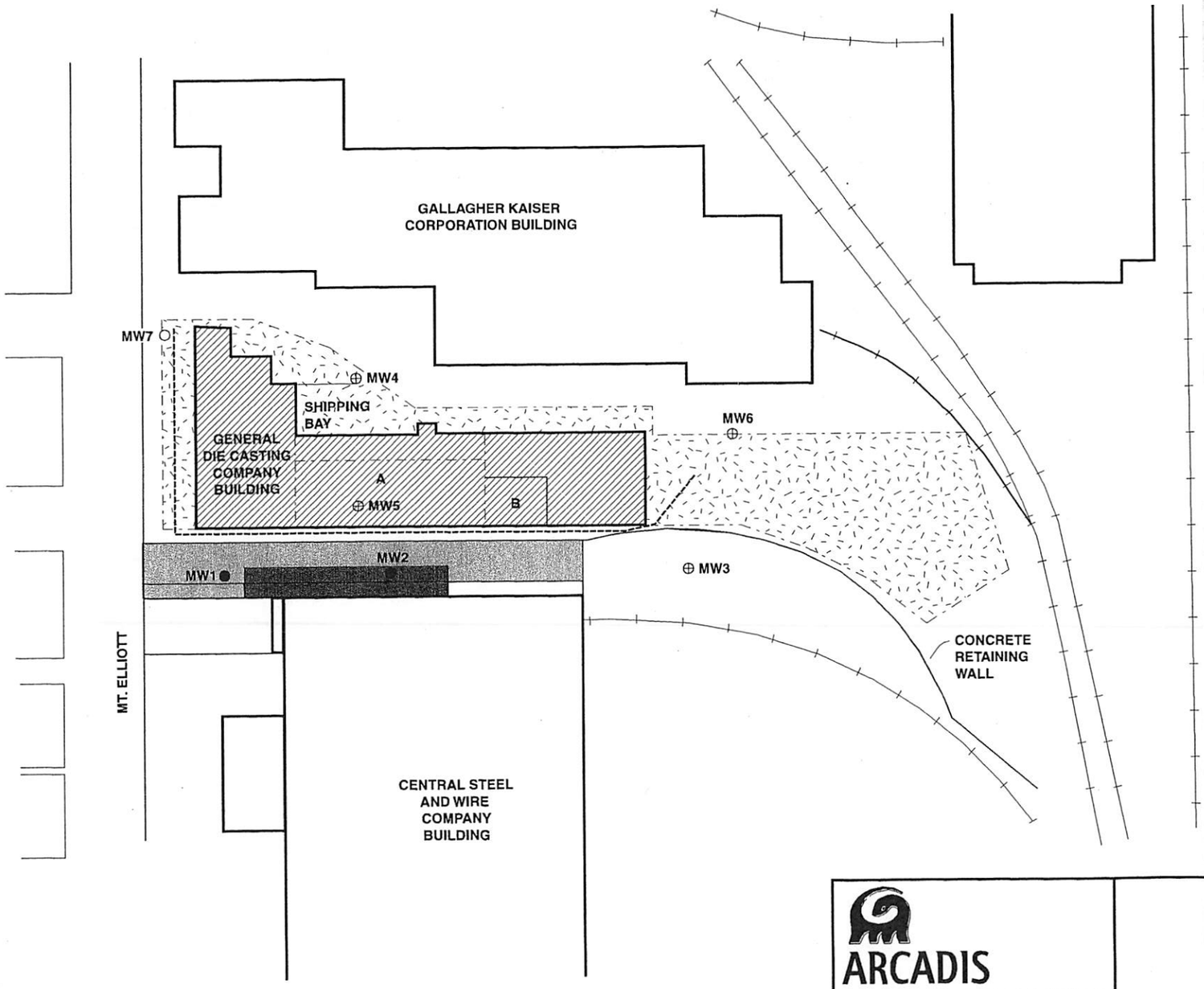
DRAFTER: ELS | APPROVED: | CHECKED: SMJ | DRAWING: CYANIDE.AI | FILE NO.: GRAPHICS | PN: GRAPH_OHNOVIMI0601 | DWG DATE: 08JUL99

ARCADIS GERAGHTY & MILLER

DISTRIBUTION OF CYANIDE IN GROUNDWATER JANUARY AND DECEMBER 1998

GENERAL DIE CASTING COMPANY
DETROIT, MICHIGAN

FIGURE
10



N

0 75 150

APPROXIMATE SCALE IN FEET

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- A — ELECTROPLATING PROCESS AREA
- B — WASTEWATER TREATMENT AREA
- ⊕ — MONITORING WELL LOCATION
- ○ — NEW MONITORING WELL LOCATION
- ● — REPLACEMENT MONITORING WELL LOCATION
- BUILDING FLOOR LEFT IN PLACE
- AREA OF EXCAVATION TO DEPTH OF 3 FEET
- AREA OF EXCAVATION TO DEPTH OF 8 FEET
- DIRECT CONTACT BARRIER
- HYDRAULIC CONTAINMENT WALL

NOTES
1. Base map developed from an aerial photograph. Detroit Edison. Dated 1981.
2. Property boundary drawing developed from a drawing by Clayton Environmental Consultants, Detroit, Michigan. Dated October 18, 1995.

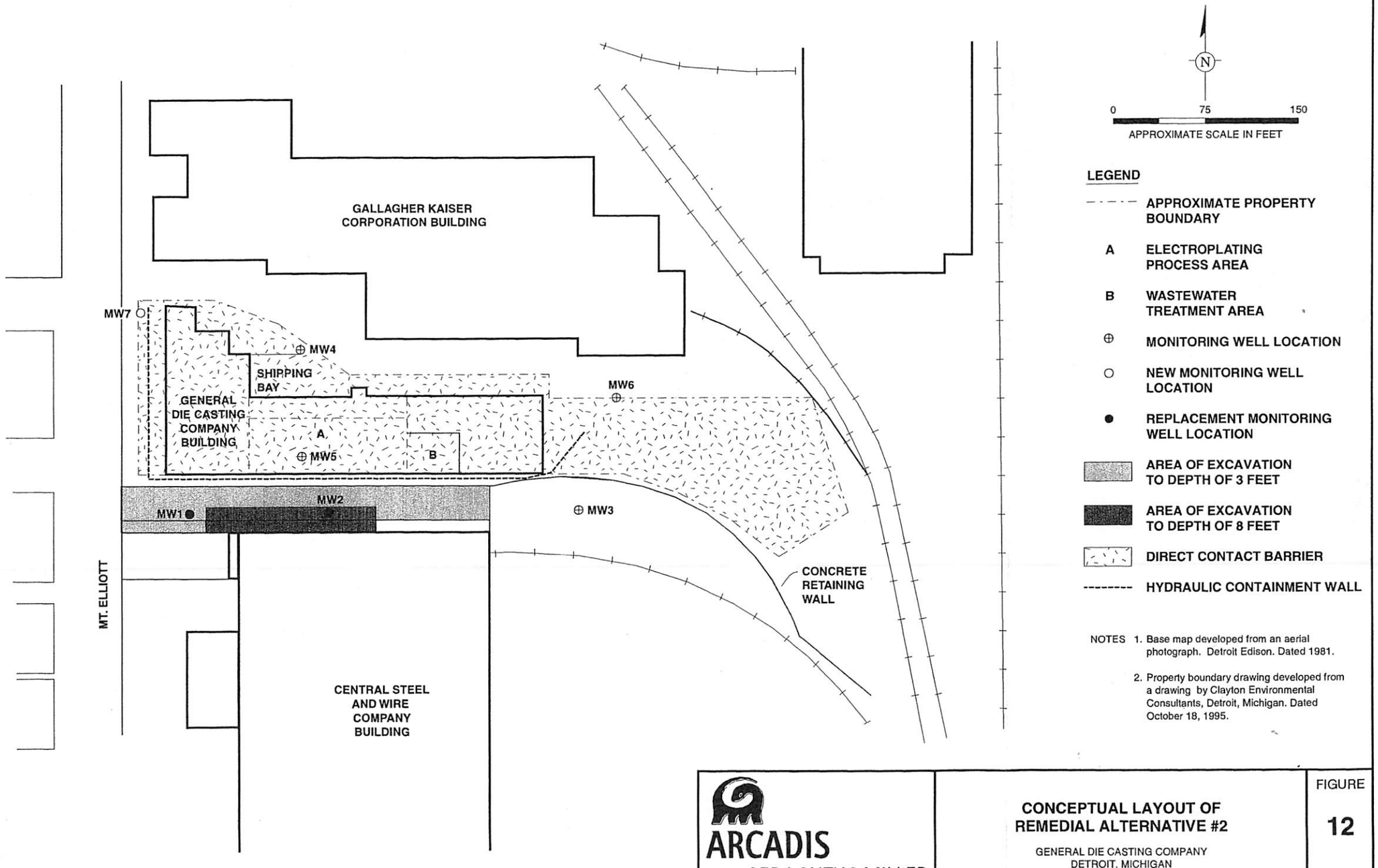
DRAFTER: ELS | APPROVED: | CHECKED: MNJ/NMK | DRAWING: AALT_1.AI | FILE NO.: GRAPHICS | PN: GRAPH_OH\NOVI\MI0601 | DWG DATE: 08jul99

ARCADIS GERAGHTY & MILLER

CONCEPTUAL LAYOUT OF REMEDIAL ALTERNATIVE #1

GENERAL DIE CASTING COMPANY
DETROIT, MICHIGAN

FIGURE
11



DRAFTER: ELS | APPROVED: | CHECKED: MNJ/NMK | DRAWING: AALT_2.AI | FILE NO.: GRAPHICS | PN: GRAPH_OHNOV/IMI0601 | DWG DATE: 08JUL99

ARCADIS GERAGHTY & MILLER

CONCEPTUAL LAYOUT OF REMEDIAL ALTERNATIVE #2

GENERAL DIE CASTING COMPANY
DETROIT, MICHIGAN

FIGURE
12

Table 1. Summary of Groundwater Quality Analytical Data, Monitoring Well Samples, General Die Casting Company, Detroit, Michigan.

Sample ID:	MW-1		MW-2		MW-3		MW-4		MW-5		MW-6		Groundwater Contact Criteria
Date Collected:	1/29/98	12/2/98	1/29/98	12/2/98	1/29/98	12/2/98	1/29/98	12/2/98	1/29/98	12/2/98	1/29/98	12/2/98	
Volatile Organic Compounds (ug/L)													
Acetone	<50	NA	130	NA	<50	NA	<50	NA	<50	NA	<50	NA	31,000,000
Benzene	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	9,400
Bromodichloromethane	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	11,000
Bromoform	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	100,000
Bromomethane	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	65,000
2-Butanone (MEK)	<25	NA	<25	NA	<25	NA	<25	NA	<25	NA	<25	NA	240,000,000
Carbon Disulfide	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	1,100,000
Carbon Tetrachloride	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	1,600
Chlorobenzene	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	68,000
Chloroethane	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	200,000
Chloroform	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	96,000
Chloromethane	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	110,000
Dibromochloromethane	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	9,500
1,1-Dichlororethane	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	2,100,000
1,2-Dichloroethane	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	11,000
1,1-Dichloroethene	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	9,000
cis-1,2-Dichloroethene	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	170,000
trans-1,2-Dichloroethene	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	190,000
1,2-Dichloropropane	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	7,500
cis-1,3-Dichloropropene	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	2600(1)
trans-1,3-Dichloropropene	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	2600(1)
Ethylbenzene	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	170,000
2-Hexanone	<25	NA	<25	NA	<25	NA	<25	NA	<25	NA	<25	NA	4,800,000
Methylene Chloride	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	110,000
4-Methyl-2-pentanone (MIBK)	<25	NA	160	NA	<25	NA	<25	NA	<25	NA	<25	NA	12,000,000
Styrene	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	3,200
1,1,2,2-Tetrachloroethane	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	2,100
Tetrachloroethene	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	5,100
Toluene	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	530,000
1,1,1-Trichloroethane	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	220,000
1,1,2-Trichlororethane	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	9,500
Trichloroethene	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	11,000
Vinyl Acetate	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	7,700,000
Vinyl Chloride	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	290
Total Xylenes	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	<5	NA	190,000

Table 1. Summary of Groundwater Quality Analytical Data, Monitoring Well Samples, General Die Casting Company, Detroit, Michigan.

Sample ID:	MW-1		MW-2		MW-3		MW-4		MW-5		MW-6		Groundwater Contact Criteria
Date Collected:	1/29/98	12/2/98	1/29/98	12/2/98	1/29/98	12/2/98	1/29/98	12/2/98	1/29/98	12/2/98	1/29/98	12/2/98	
Semi-Volatile Organic Compounds (ug/L)													
Acenaphthene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	4,200
Acenaphthylene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	3,900
Anthracene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	43
Benzo(a)anthracene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	5
Benzo(a)pyrene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	5
Benzo(b)fluoranthene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	5
Benzo(g,h,i)perylene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	5
Benzo(k)fluoranthene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	21
Chrysene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	5
Dibenzo(a,h)anthracene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	5
Fluoranthene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	210
Fluorene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	2,000
Indeno(1,2,3-cd)pyrene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	5
2-Methylnaphthalene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	32,000
Naphthalene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	31,000
Phenanthrene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	1,000
Pyrene	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	140
Dissolved Metals (ug/L)													
Arsenic	<10	23	<500	89	<10	<5	<10	<5	<10	10	<10	15	4,700
Barium	180	260	<500	<200	250	350	30	<200	56	<200	280	340	15,000,000
Cadmium	<5	<0.5	<250	4.9	<5	<0.5	<5	1.5	<0.5	<0.5	<5	0.5	210,000
Total Chromium	NA	54	<500	<50	NA	<50	NA	<50	NA	<50	NA	<50	1,000,000
Chromium (III)	<10	NA	<500	NA	<10	NA	<10	NA	410	NA	<10	NA	320,000,000
Chromium (VI)	<10	14	<500	<2,000 *	<10	<10	<10	<10	<10	35	<10	11	1,000,000
Copper	20,000	100,000	1,400,000	1,500,000	<25	56	<25	<25	71	130,000	<25	<25	8,100,000
Lead	<5	<25 *	<250	<200 *	<5	<30	<5	<3	<5	<25 *	<5	<3	ID
Mercury	<0.2	<0.2	<0.2	0.26	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	56
Selenium	26	63	1,100	1,100	<10	<5	<10	<5	62	150	<10	<5	1,100,000
Silver	<10	<0.5	<500	<0.5	<10	<0.5	<10	<0.5	<10	<0.5	<10	<0.5	1,000,000
Zinc	23	<100 *	<1,000	970	<20	<20	<20	340	53	<100 *	<20	<20	70,000,000

See notes on page 3.

Table 1. Summary of Groundwater Quality Analytical Data, Monitoring Well Samples, General Die Casting Company, Detroit, Michigan.

Sample ID:	MW-1		MW-2		MW-3		MW-4		MW-5		MW-6		Groundwater Contact Criteria
Date Collected:	1/29/98	12/2/98	1/29/98	12/2/98	1/29/98	12/2/98	1/29/98	12/2/98	1/29/98	12/2/98	1/29/98	12/2/98	
Inorganic Compounds (ug/L)													
Total Cyanide	20,000	98,000	**1,900,000**	**2,200,000**	<10	<10	77	<10	65,000	140,000	90	23	650,000
Weak & Dissociable	20,000	63,000	**800,000**	**980,000**	<10	<10	19	<10	61,000	62,000	<10	<10	650,000
Total Reactive Cyanide	<10,000	NA	640,000	NA	<10,000	NA	<10,000	NA	19,000	NA	<10000	NA	650,000

Notes:

(1) cis and trans isomer concentrations must be added together for comparison to 2,600 ug/L criterion.

ID Inadequate data to develop a criterion.

NA Not analyzed.

Bold Concentration equals or exceeds applicable cleanup criteria.

< Analyte not detected at or above method detection limit.

* Elevated detection limits were reported due to sample matrix interference which required sample or extract dilution.

All concentrations are reported in micrograms per liter (ug/L).

Cleanup criteria are published in the Michigan Department of Environmental Equality Integrated Table of Part 201 Cleanup Criteria, Revised May 28,1999.

Table 2. Summary of Groundwater Analytical Data, Geoprobe Samples, General Die Casting Company, Detroit, Michigan.

Sample ID:	GP-1	GP-3	GP-4 s	GP-4 d	GP-6	GP-8	Groundwater
Date sampled:	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	Contact
Sample Depth:	4-5 feet	4-5 feet	4-5 feet	6-7 feet	4-5 feet	4-5 feet	Criteria
Total cyanide	370,000	430,000	310,000	**1,000,000**	110,000	28,000	
Amenable cyanide	320,000	370,000	280,000	**920,000**	<20	26,000	650,000
Weak acid dissoc. cyanide	360,000	480,000	290,000	210,000	110,000	29,000	

See notes on page 2.

Table 2. Summary of Groundwater Analytical Data, Geoprobe Samples, General Die Casting Company, Detroit, Michigan.

Sample ID:	GP-10	GP-11	GP-13	GP-15	GP-17	GP-19	Groundwater
Date sampled:	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/1/99	Contact
Sample Depth:	4-5 feet	4-5 feet	4-5 feet	4-5 feet	4-5 feet	4-5 feet	Criteria
Total cyanide	17	14	66	190,000	55,000	1,300	
Amenable cyanide	NA	NA	41	140,000	54,000	300	650,000
Weak acid dissoc. cyanide	<10	<10	70	160,000	44,000	1,300	

Notes:

NA Not analyzed.

< Analyte not detected at or above method detection limits.

Bold Concentration equals or exceeds applicable cleanup criterion.

Analytical results are reported in micrograms per liter (µg/L).

Cleanup criteria for cyanides are based on amenable cyanide analysis.

Cleanup criteria are published in the MDEQ Integrated Table of Part 201 Cleanup Criteria, Revised May 28, 1999.

Table 3. Soil Quality Analytical Data. January 26, 1998 to January 27, 1998. General Die Casting Company, Detroit, Michigan.

Sample ID:	MW-1	MW-2	MW-3	Statewide Default Background Levels	Calculated Site Specific Background Levels	Soil Criteria Protective of Groundwater Contact	Residential Soil Direct Contact Criteria
Date Sampled:	1/26/98	1/26/98	1/26/98				
Sample Depth:	2-4 ft.	2-4 ft.	2-4 ft.				
TOTAL METALS							
Arsenic	4,500	3,500	2,900	5,800	NC	2,200,000	6,600
Barium	28,000	56,000	66,000	75,000	NC	1,000,000,000	30,000,000
Cadmium	<570	<570	<600	1,200	NC	250,000,000	420,000
Chromium III	11,000	7,500	11,000	18,000[1]	NC	1,000,000,000	630,000,000
Chromium VI	<440	<450	<460	18,000[1]	NC	300,000,000	3,000,000
Copper	66,000	1,100,000	13,000	32,000	NC	1,000,000,000	16,000,000
Lead	6,900	22,000	6,400	21,000	865,000	ID	400,000[3]
Mercury	<11	29	14	130	NC	47,000	130,000
Selenium	<1,100	<1,100	<1,200	410	NC	88,000,000	2,100,000
Silver	<1,100	<1,100	<1,200	1,000	NC	230,000,000	2,000,000
Zinc	28,000	31,000	29,000	47,000	NC	1,000,000,000	140,000,000
INORGANICS							
Cyanide, total	18,000	280,000	<1,200	NA	NC	250,000[2]	250,000
Cyanide, weak & dissociable	18,000	230,000	<1,200	NA	NC		
Cyanide, reactive	<10,000	41,000	<10,000	NA	NC		

See notes on page 2.

Table 3. Soil Quality Analytical Data. January 26, 1998 to January 27, 1998. General Die Casting Company, Detroit, Michigan.

Sample ID:	MW-4	MW-5	MW-6	Statewide Default Background Levels	Calculated Site Specific Background Levels	Soil Criteria Protective of Groundwater Contact	Residential Soil Direct Contact Criteria
Date Sampled:	1/27/98	1/27/98	1/27/98				
Sample Depth:	2-4 ft.	2-4 ft.	2-4 ft.				
TOTAL METALS							
Arsenic	5,900	2,100	5,100	5,800	NC	2,200,000	6,600
Barium	120,000	23,000	200,000	75,000	NC	1,000,000,000	30,000,000
Cadmium	<550	<600	<570	1,200	NC	250,000,000	420,000
Chromium III	60,000	4,500	6,700	18,000[1]	NC	1,000,000,000	630,000,000
Chromium VI	<430	<470	<450	18,000[1]	NC	300,000,000	3,000,000
Copper	130,000	130,000	10,000	32,000	NC	1,000,000,000	16,000,000
Lead	100,000	16,000	430,000	21,000	865,000	ID	400,000[3]
Mercury	320	30	210	130	NC	47,000	130,000
Selenium	<1,100	<1,200	<1,100	410	NC	88,000,000	2,100,000
Silver	<1,100	<1,200	<1,100	1,000	NC	230,000,000	2,000,000
Zinc	340,000	13,000	33,000	47,000	NC	1,000,000,000	140,000,000
INORGANICS							
Cyanide, total	14,000	<1,200	<1,100	NA	NC	250,000[2]	250,000
Cyanide, weak & dissociable	<1,100	<1,200	<1,100	NA	NC		
Cyanide, reactive	<10,000	10,000	<10,000	NA	NC		

Notes:

Analytical results are reported in micrograms per kilogram (µg/kg).

Cleanup criteria are published in the Michigan Department of Environmental Equality (MDEQ) Integrated Table of Part 201 Cleanup Criteria, Revised May 28, 1999.

NA Criterion not available.

NC Not calculated.

ID Inadequate data to develop criterion.

< Analyte not reported at or above method detection limits.

[1] Background default level of 18,000 µg/kg should be compared against total chromium concentration (Chromium III + Chromium VI).

[2] Comparison of cyanide concentration to soil criteria is based on total cyanide analysis.

[3] A draft Industrial Soil Direct Contact Criteria for lead at 900,000 ug/kg has been proposed by the MDEQ.

Table 4. Soil Analytical Data, General Die Casting Company, Detroit, Michigan.

Sample ID:	GP-1	GP-1	GP-1	GP-2	GP-2	GP-2	GP-3	GP-3	GP-3	GP-4	GP-4	GP-4	GP-5	Direct
Sample parameter depth:	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	Contact
Date sampled:	3/1/99	3/1/99	3/1/99	3/1/99	3/1/99	3/1/99	3/1/99	3/1/99	3/1/99	3/2/99	3/2/99	3/2/99	3/1/99	Criteria
Total cyanide	1,400	3,600	240,000	<220	31,000	**730,000**	400	8,900	**360,000**	<220	<220	6,700	<230	250,000
Amenable cyanide	1,400	3,600	48,000	NT	<560	87,000	NT	<550	<560	NT	NT	6,700	NT	
Weak acid dissoc. cyanide	<1100	<1100	<1100	NT	<1100	<1100	NT	<1100	<1100	NT	NT	2,300	NT	

See notes on page 5.

Table 4. Soil Analytical Data, General Die Casting Company, Detroit, Michigan.

Sample ID:	GP-5	GP-5	GP-6	GP-6	GP-6	GP-7	GP-7	GP-7	GP-8	GP-8	GP-8	GP-9	GP-9	Direct
Sample parameter depth:	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	Contact
Date sampled:	3/1/99	3/1/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	Criteria
Total cyanide	<230	1,300	<220	<220	23,000	2,800	470	360	<220	1,200	3,200	<210	<220	250,000
Amenable cyanide	NT	1,300	NT	NT	9,200	1,100	NT	NT	NT	1,200	3,200	NT	NT	
Weak acid dissoc. cyanide	NT	<1100	NT	NT	<1100	<1100	NT	NT	NT	<1000	2,400	NT	NT	

See notes on page 5.

Table 4. Soil Analytical Data, General Die Casting Company, Detroit, Michigan.

Sample ID:	GP-9	GP-10	GP-10	GP-10	GP-11	GP-11	GP-11	GP-12	GP-12	GP-12	GP-13	GP-13	GP-13	Direct
Sample parameter depth:	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	Contact
Date sampled:	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	Criteria
Total cyanide	<220	<220	<220	870	<220	<230	<230	<220	<220	<230	<220	<220	520	250,000
Amenable cyanide	NT	NT	NT	870	NT	NT	NT	NT	NT	NT	NT	NT	<560	
Weak acid dissoc. cyanide	NT	NT	NT	<1100	NT	NT	NT	NT	NT	NT	NT	NT	<1100	

See notes on page 5.

Table 4. Soil Analytical Data, General Die Casting Company, Detroit, Michigan.

Sample ID:	GP-14	GP-14	GP-14	GP-15	GP-15	GP-15	GP-16	GP-16	GP-16	GP-17	GP-17	GP-17	Direct
Sample parameter depth:	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	Contact
Date sampled:	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/2/99	3/1/99	3/1/99	3/1/99	3/2/99	3/2/99	3/2/99	Criteria
Total cyanide	<230	<220	5,400	<220	480	5,700	<220	3,100	59,000	<220	<220	410	250,000
Amenable cyanide	NT	NT	5,400	NT	NT	3,500	NT	<560	14,000	NT	NT	NT	
Weak acid dissoc. cyanide	NT	NT	<1000	NT	NT	<1100	NT	NT	<1100	NT	NT	NT	

See notes on page 5.

Table 4. Soil Analytical Data, General Die Casting Company, Detroit, Michigan.

Sample ID:	GP-18	GP-18	GP-18	GP-19	GP-19	GP-19	GP-20	GP-20	GP-20	Direct
Sample parameter depth:	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	(0-1 ft)	(1-2 ft)	(2-3 ft)	Contact
Date sampled:	3/1/99	3/1/99	3/1/99	3/1/99	3/1/99	3/1/99	3/1/99	3/1/99	3/1/99	Criteria
Total cyanide	<240	970	6,700	<220	<220	<220	<220	<220	500	250,000
Amenable cyanide	NT	<550	1,600	NT	NT	NT	NT	NT	NT	
Weak acid dissoc. cyanide	NT	<1100	<1100	NT	NT	NT	NT	NT	NT	

Notes:

< Analyte not reported at or above method detection limit.

µg/kg Micrograms per kilogram.

Bold Concentration equals or exceeds applicable cleanup criterion.

NT Not tested if total cyanide was not detected or was detected below detection limits of associated criterion.

Cleanup criteria for cyanide are based on total cyanide analysis.

Cleanup criteria published in the Integrated Table of Part 201 Cleanup Criteria, Revised May 28, 1999.

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Table 5. Detailed Costs for Remedial Alternative RA-1, General Die Casting Company, Detroit, Michigan.

PROCESS OPTION/DESCRIPTION	UNIT COST	UNIT	QUANTITY	TOTAL COST
SITE PREPARATION				
Remove Fence	$400	LS	1	$400
Mob/Demob	$3,500	LS	1	$3,500
Clearing and Grubbing	$750	LS	1	$750
Building Demolition	$60,000	LS	1	$60,000
INSTALLATION OF SHEETPILE WALL				
Groundwater Containment	$14.95	sf	6,150	$91,943
EXCAVATION AND DISPOSAL				
Sampling for Landfill Disposal	$2,620	LS	1	$2,620
Removal of Existing Asphalt	$2.64	cy	132	$348
Excavation Shoring	$10.15	sf	2,775	$28,166
Excavation	$2.12	cy	1,600	$3,392
Soil Drying	$3.00	cy	1,600	$4,800
Transportation	$11.10	cy	1,980	$21,978
Disposal	$11.00	cy	1,980	$21,780
Backfill	$10.49	cy	810	$8,497
DEWATERING				
Pump, Store and Transport Water	$19,850.00	LS	1	$19,850
Decontamination of Frac Tanks	$4,534.00	LS	1	$4,534
Disposal of Nonhazardous Water	$0.75	gallon	85,000	$63,750
VERIFICATION SAMPLING	$685.00	sample	20	$13,700
DIRECT CONTACT BARRIER				
Powerwash Building Foundation	$5,000.00	LS	1	$5,000
Fill Open Pits with Concrete	$50.00	cy	17	$850
Asphalt Installation	$5.61	sy	2,456	$13,778
REPORT DOCUMENTATION	$10,000.00	LS	1	$10,000.00
INSTALLATION OF MONITORING WELLS	$500.00	well	3	$1,500.00
			Capital Cost	$381,136
			Engineering (10%)	$38,114
			Management (15%)	$57,170
			Contingency (25%)	$95,284
			TOTAL CAPITAL COST	**$571,704**

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Table 5. Detailed Costs for Remedial Alternative RA-1, General Die Casting Company, Detroit, Michigan.

PROCESS OPTION/DESCRIPTION	UNIT COST	UNIT	QUANTITY	TOTAL COST
GROUNDWATER SAMPLING				
Sampling - 4 monitoring wells	$1,500.00	event	1	$1,500.00
Analytical Costs	$680.00	sample	4	$2,720.00
Sampling Report	$5,000.00	report	1	$5,000.00
Cap Inspection and repair	$1,000.00	yr	1	$1,000.00
			SUBTOTAL	$10,220
			Contingency (25%)	$2,555
			COST PER MONITORING EVENT	**$12,775**
		O&M costs:	1st Year (4 quarterly events)	$51,100
			Years 2 through 30 (annual events)	$12,775
			TOTAL PRESENT WORTH (MONITORING COSTS)	**$254,200**
			TOTAL PRESENT WORTH (CAPITAL AND O&M COSTS)	**$825,900**

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Table 6. Detailed Costs for Remedial Alternative RA-2, General Die Casting Company, Detroit, Michigan.

PROCESS OPTION/DESCRIPTION	UNIT COST	UNIT	QUANTITY	TOTAL COST
SITE PREPARATION				
Remove Fence	$400	LS	1	$400
Mob/Demob	$3,500	LS	1	$3,500
Clearing and Grubbing	$750	LS	1	$750
Building Demolition	$60,000	LS	1	$60,000
Foundation Demolition	$125.00	cy	800	$100,000
Foundation Transportation	$11.10	cy	800	$8,880
Foundation Disposal	$11.00	cy	800	$8,800
INSTALLATION OF SHEETPILE WALL				
Groundwater Containment	$14.95	sf	6,150	$91,943
EXCAVATION AND DISPOSAL				
Sampling for Landfill Disposal	$2,620	LS	1	$2,620
Removal of Existing Asphalt	$2.64	cy	132	$348
Excavation Shoring	$10.15	sf	2,775	$28,166
Excavation	$2.12	cy	1,600	$3,392
Soil Drying	$3.00	cy	1,600	$4,800
Transportation (swell factor included)	$11.10	cy	1,980	$21,978
Disposal (swell factor included)	$11.00	cy	1,980	$21,780
Backfill	$10.49	cy	810	$8,497
DEWATERING				
Pump, Store and Transport Water	$19,850.00	LS	1	$19,850
Decontamination of Frac Tanks	$4,534.00	LS	1	$4,534
Disposal of Nonhaz Water	$0.75	gallon	85,000	$63,750
VERIFICATION SAMPLING	$685.00	sample	20	$13,700
DIRECT CONTACT BARRIER				
Backfill	$10.49	cy	1,100	$11,500
Compaction of Fill Area	$2.00	cy	1,100	$2,200
Asphalt Installation	$5.61	sy	4,790	$26,880
REPORT DOCUMENTATATION	$10,000.00	LS	1	$10,000.00
INSTALLATION OF MONITORING WELLS	$500.00	well	4	$2,000.00
			Capital Cost	$520,268
			Engineering (10%)	$52,027
			Management (15%)	$78,040
			Contingency (25%)	$130,067
			TOTAL CAPITAL COST	**$780,402**

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Table 6. Detailed Costs for Remedial Alternative RA-2, General Die Casting Company, Detroit, Michigan.

PROCESS OPTION/DESCRIPTION	UNIT COST	UNIT	QUANTITY	TOTAL COST
GROUNDWATER SAMPLING				
Sampling - 4 monitoring wells	$1,500.00	event	1	$1,500.00
Analytical Costs	$680.00	sample	4	$2,720.00
Sampling Report	$5,000.00	report	1	$5,000.00
Cap Inspection and Repair	$1,000.00	yr	1	$1,000.00
			SUBTOTAL	$10,220
			Contingency (25%)	$2,555
			COST PER MONITORING EVENT	**$12,775**
	O&M costs:		1st Year (4 quarterly events)	$51,100
			Years 2 through 30 (annual events)	$12,775
			TOTAL PRESENT WORTH (MONITORING COSTS)	**$254,200**
			TOTAL PRESENT WORTH (CAPITAL AND O&M COSTS)	**$1,034,600**